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Assessment of Post-Harvest Storage Stability and Physico-Chemical Properties of Guava (*Psidium guajava*) at Different Maturity Stages

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Guava (*Psidium guajava*) is one of the most popular, export promising, quick growing fruit cultivated throughout the country for commercial purposes. It is an alternative cheap vitamin C rich fruit for peoples of low income level. Cheapest post-harvest storage method is very rare to reduce losses, maintain nutritional quality and increase the consumer acceptability. Therefore, in our present study we measured their physico-chemical composition and the influence of different stages of maturation (immature, mature, ripen) on storage stability at different temperature treatment. We observed the highest post-harvest shelf life (17 days) in ripen guava at T_2,13 days (immature and mature) at T_2,

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T_3 & lowest 11 days at T_1. Maximum weight loss (18%, immature) at T_1 and minimum weight loss (0.14%, mature) at T_2. High moisture (84.34%ripen) & relatively low moisture (84%, immature). Maximum ash % (4.54%, ripen) & minimum ash % (3.81%, immature).TS (17.79%, immature) followed by (15.72%, mature) & (15.66%, ripen). Vitamin C content suddenly found at peak level in mature stage (118 mg/100 gm) and 86 mg/100 gm, 76 mg/100 gm in immature and ripen stage respectively. pH level gradual decreased according to increase of maturation (immature 4.52 >mature 3.54>ripen 2.92). Green color lasts for 1st three days in immature and mature guava and yellow color lasts till end stage at T_1, T_2, T_3. Olive color was seen in last stage of T_2. Black spots were common at last unacceptable stages. Our current research suggests that, wrapped storage at freezing temperature is the suitable inexpensive home level method for highest storage stability for growers which slow down the rate of undesirable changes of guava of all maturity stages. Moreover, mature stage contains the highest vitamin C.

Keywords: Storage stability; physico-chemical properties; different maturity stage.

1. INTRODUCTION

Guava is one of the most common and important fruits in Bangladesh. It claims to be the most important fruit in area of production after mango. The guava *(Psidium guava*); a member of the family Myrtaceae is one of the most popular and commercially important fruit in tropical and sub-tropical regions of the world. It is also a native fruit of the American tropics. It is a large tropical evergreen shrub or small shade tree and well known in the islands for its edible fruit. It is native too and widely distributed in Mexico and Central America. However, the plant is cultivated today from the west coast of Africa to the Pacific region, including India and China, with varieties originally introduced over the past 300 years from the United States [1]. This fruit is well accepted to the consumers all over the world for its special organoleptic features such as excellent flavour, pleasant aroma, luscious taste, lovely size and attractive color [2]. Guava is a valuable, popular and commercially important fruits in Bangladesh [3]. The consumption trend of fresh tropical fruits and their products is increasing steadily due to consumer's education on their exotic flavors, nutritive value, and phytochemical content with potential health effects [4]. It is commercially important because of its flavor and aroma. It is nutritionally important due to its excellent source of vitamin C, niacin, riboflavin and vitamin A. Guava fruit (*Psidium guajava* L.), an exotic from the tropics characterized by its appealing flavor and aroma, has been catalogued as one of the most nutritious fruits due to its high content of phytochemicals, especially ascorbic acid [2]. Guava's importation as a fresh fruit is somewhat limited within the US for two main reasons: quarantine issues surrounding its importation and its highly perishable nature. Guavas are considered excellent sources of antioxidant phytochemicals, which include ascorbic acid, carotenoids, antioxidant dietary fiber and polyphenolics. After acerola cherries, guava has reported the second highest concentration of ascorbic acid (ranging from 60-1000 mg/100 g) of all fruits [5]. Carotenoids, which are yellow, red, and orange pigments, have demonstrated many beneficial health effects related to their antioxidant properties ("*Psidium guajava*," 2005). Guava's major carotenoid, lycopene, is responsible for the pink coloration in pink guava's flesh. The types and amounts of sugars determine the flavor of guavas. Generally, total sugars increase initially and then decreases during ripening. However, the relative proportions of its chemical composition change according to the cultivar and environmental conditions such as the climate and soil (Conservation and Sustainable Use of Plant Genetic Resources in Bangladesh, n.d.). Depending on the cultivar, the flavor compound may accumulate at different proportions during ripening, and thus may result in guava fruits having distinctive aroma and tastes [2].

Guava is a climacteric fruit so physico-chemical changes continuously occur after harvest till fruit become unfit for consumption and suffers from post-harvest losses. After harvesting guava may be stored 5-15 days at room temperature. The taste and nutrient content in the guava varied at the time of storage. Guava is an export promising quick growing fruit grow in Bangladesh. Although guava grows throughout the country it is confined in some areas where guava is cultivated for commercial purposes. During harvesting season market glut occurs in the guava producing areas. Due to lack of marketing and storage facilities the growers bound to sell their produce at throw away prices and huge quantity of guava spoiled.

As estimated by [6] an approximately 30 - 50% fruit goes waste during post-harvest handling, storage and ripening. This post- harvest loss is highly prominent in guava because of its high perishability. Once it fully ripe, the fruit becomes soggy and its edibility and marketing quality deteriorates rapidly. The prevention of losses of the seasonal surplus of the fruit by preservation techniques at farmer's level and as well as industrial scale should be warranted. Moreover, this will stimulate an increase in production and bring better return to the guava growers. But unfortunately, preservation of guava in Bangladesh is not well developed up to the volume of its annual production. It is therefore essential to investigate to develop suitable inexpensive method for preservation of guava.

Naturally preserving system of guava varieties in various stages is very rare in southern part of Bangladesh. In this study, the influence of different stages of maturation on storage stability and the volatile and non-volatile chemical composition was investigated. The study was conducted that how many days they will remain acceptable under different temperature treatment.

2. MATERIALS AND METHODS

2.1 Location of the Studies

The present study was conducted at the BCM Lab. and CENTRAL Lab., Patuakhali science and Technology University (PSTU), Dumki, Patuakhali. Patuakhali District (Barishal) area of 3220.15 sq. km, located in between 21°48' and 22°36' north latitudes and in between 90°08' and 90°41' east longitudes.

2.2 Sample Collection

Fresh Guava samples of different maturity stages (mature, immature and ripen) were collected from Kabi Begum Sufia Kamal Hall, Germplasm Centre, Patuakhali Science and Technology University and local markets of Dumki. Samples were collected in undamaged and free from any obvious pathogen infection and transferred to the laboratory in polythene bags to prevent moisture loss.

2.3 Sample Preparation, Grading and Size

The different stages of guava were harvested from guava owner and the harvesting was done in the afternoon. Then samples were washed in bath to remove soil or dusts which may cause potential micro-organism attack during storage. Then they were graded into GA & GB of every stage on the basis of their acceptability and firmness.

2.4 Methods for Post-harvest Physico-Chemical Analysis

The guava was observed for physiological changes i.e. storing shelf-life, color change, weight loss etc. and analyzed chemical changes i.e. moisture, ash, pH, total solids (TS), vitamin C etc. For Chemical analysis, all the determinations were done in triplicate and the results were expressed as average and had been presented both in percentage and in acceptability score.

2.5 Data Management and Analysis

The data was analyzed by Microsoft Office 10. Results were expressed as frequencies and percentages (%).

3. RESULTS AND DISCUSSION

3.1 Immature Guava

Physical and Physio-chemical properties of immature guava have been presented and discussed in the following sub –Headlines.

3.1.1 Physical properties

3.1.1.1 Shelf life

Individual wrapping reduced the magnitude of changes during storage and preserved freshness of wrapped fruits. All bags with fruits were weighted and put in ventilated carton box. Sample T_1 were stored normal condition (room temperature) at 25°C, Sample T_2 were stored freezing condition at 0°C and Sample T_3 were stored refrigeration condition at 1.6°C with 90-95% relative humidity, the fruits were taken end of the shelf life to determine changes in quality during storage in different condition.

Table 1. Post-harvest shelf-life of immature guava (S_1)

Storage condition	Self-life (Days)
Room temp. (T_1)	11
Freezing temp. (T_2)	13
Refrigeration temp. (T_3)	13

In the present study, immature fruit shows rapid deteriorations during normal storage condition in

their bioactive and biochemical constituents by day-11 of storage. Immature guava showed highest post-harvest life (13 days) during freezing & refrigeration condition. The limit temperature for storing guava fruit without 'chilling' is 9.5ºC, but in this experiment the temperature of 8ºC was enough to hold the fruit with no change in quality.

3.1.1.2 Weight loss

The results were expressed as the percentage loss of initial weight. The post-harvest treatment used in the present study exhibited more pronounced effect of total weight loss in Guava. The fruits of each treatment were individually weighed by using an electric balance and kept for storage. The sample of immature guava (S_1) was kept in normal room temperature at 25ºC, T_2 in freezing temperature at 0ºC, and T_3 in refrigerated temperature 1.6ºC. Storage periods of sample (1-13 days after the experiment started). Weight loss was observed between 1 day of interval to the end stage of post-harvest life in optimum immature guava fruits res pectively.

High weight loss (18.00%) was seen during storage on room temperature condition of immature guava, medium wt. loss (16.37%) during freezing storage condition and 15.16% wt. loss during refrigeration storage condition. It was seen that the maximum percentage of total weight loss of immature guava under post-harvest treatment was found in the sample T_1 and minimum was in T_3. This change in percentage of weight loss may be due to the change in the respiration rate environmental factor (temp. relative humidity, air etc.) stages of maturity of immature guava and storage condition etc.

3.1.1.3 Color change during storage

Days required reaching different stages of color during storage. Color changes could be observed visibly during storage in different condition of guava (immature). Black spots were seen all over the surface area and became inconsumable in the last stage of T_1. Yellow color was present with black spots in refrigeration storage condition (T_2) and olive-green color present in freezing storage condition (T_3) with acceptable quality.

3.1.2 Physico-chemical properties

Immature fruit showed a rapid deterioration in their bioactive and biochemical constituents after harvest. Fruits are acidic when immature, it is used as vegetable and eaten fresh, also used for making pickle.

3.1.2.1 Moisture content

Moisture refers to the presence of a liquid especially water, often in trace amounts. Small amounts of water may be found, for example, in the air (humidity), in foods, and in various commercial products. Moisture content of immature guava was 84%.

3.1.2.2 Ash content

The ash content is a measure of the total amount of minerals present within a food, whereas the mineral content is a measure of the amount of specific inorganic components present within a food, such as Ca, Na, K and Cl. Immature guava contained 3.81% ash.

3.1.2.3 Total solid (TS)

The basic principle of this technique is that water has a lower boiling point than the other major components within foods, e.g., lipids, proteins, carbohydrates and minerals. Sometimes a related parameter, known as the total solids, is reported as a measure of the moisture content. The total solids content is a measure of the amount of material remaining after all the water has been evaporated. Total solid content found in immature guava is 15.79%.

3.1.2.4 Ascorbic acid (Vitamin C) content

Immature guava contained 86 mg/100 gm of Vitamin C. The destruction of active antioxidant compounds such as vitamin C is common by the heating process during processing. Vitamin C is very unstable to heat.

3.1.2.5 pH level

Immature guava contained pH 4.52.

3.2 Mature Guava

3.2.1 Physical properties

3.2.1.1 Shelf-life

Sample S_2 were stored normal condition (room temperature) at 25°C, freezing condition at 0°C and refrigeration condition at 1.6°C with 90-95% relative humidity, the fruits were taken end of the shelf life to determine changes in quality during storage in different condition.

Table 2. The percentages of weight loss of guava (immature) under different post-harvest temperature treatments with storage time

Date	Room temp. (T_1) (gm)	Freezing temp.(T_2) (gm)	Refrigeration temp. (T_3) (gm)
1st day	45.392	49.650	46.922
3rd day	44.950	48.951	45.007
5th day	42.552	47.802	43.894
7th day	40..541	45.320	42.540
9th day	39.023	43.213	41.221
11th day	37.221	42.112	40.429
13th day	Rotten	41.520	39.808
Weight loss (gm)	8.171	8.130	7.114
% of weight loss	18.00	16.37	15.16

Table 3. Color changes of guava (immature) during storage

Date	Room temp. (T_1)	Freezing temp.(T_2)	Refrigeration temp. (T_3)
1st day	Green	Green	Green
3rd day	Green	Green	Green
5th day	Green	Green	Light Green
7th day	Yellowish Green	Green	Yellowish
9th day	Yellow	Olive Green	Yellow, Light Spot
11th day	Yellow, spot	Olive Green	Yellow, Black spot
13th day	black spot	Olive Green	Yellow, Black spot

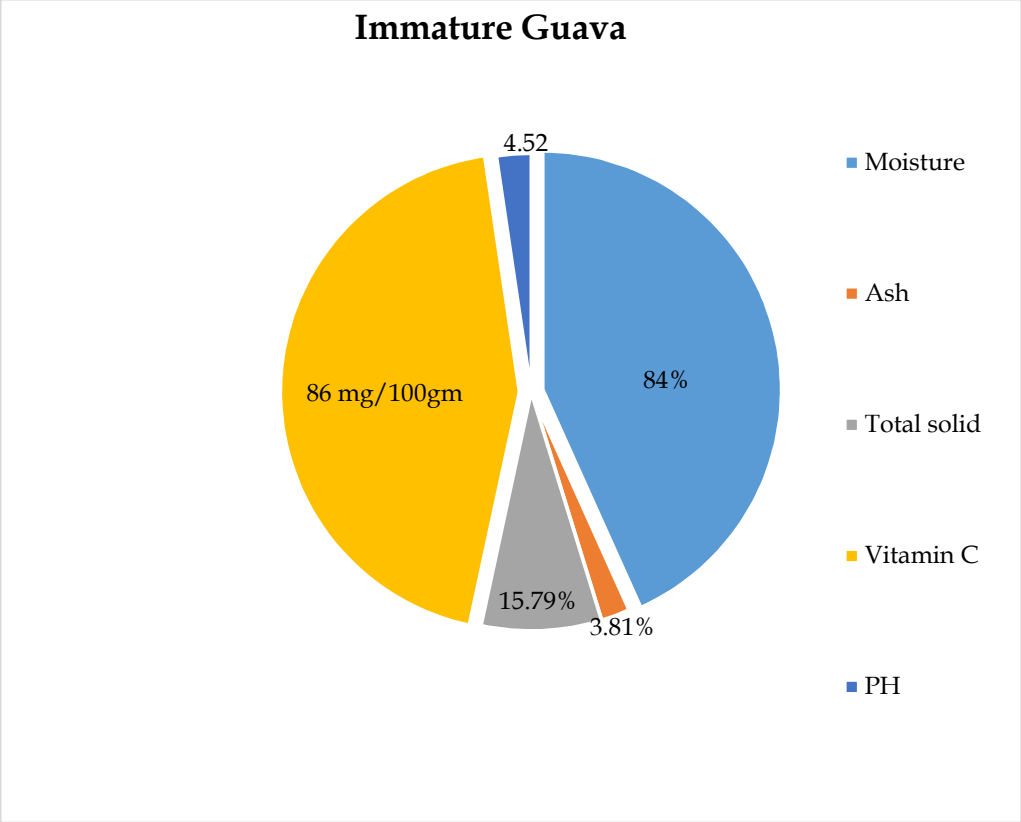

Fig.1. Ash, moisture, total solid, pH and ascorbic acid content of immature guava

Table 4. **Post harvest shelf-life of mature guava**

Storage Condition	Sample	Self-life (Days)
Room temp. (T_1)	Grade A	11
	Grade B	11
Freezing temp. (T_2)	Grade A	13
	Grade B	13
Refrigerationtemp. (T_3)	Grade A	13
	Grade B	11

Table 5. Weight loss of mature guava under different post-harvest temperature treatments with storage time

Date	Room temp. (T_1)		Freezing temp. (T_2)		Refrigeration temp. (T_3)	
	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B
1st day	99.212	98.582	88.275	90.550	94.102	98.598
3rd day	97.835	96.004	88.179	90.502	94.002	98.101
5th day	95.739	92.952	88.101	90.485	93.936	97.159
7th day	94.66l	92.510	87.991	90.470	93.495	95.169
9th day	93.523	91.675	87.803	90.455	91.895	94.002
11th day	89.088	88.865	87.750	90.435	91.245	92.224
13th day	Rotten	Rotten	87. 699	90.420	90.895	Rotten
Weight loss	10.124	9.717	0.576	0.130	3.207	6.374
% of wt. loss	10.20	9.86	0.65	0.14	3.41	6.46

In the present study, mature fruit S_2 (GB) showed rapid deteriorations during refrigeration storage condition in their bioactive and biochemical constituents by day-13 of storage. Mature guava S_2 (GA & GB) showed highest post-harvest life (13 days) during storage of freezing condition (GA & GB) deteriorations during storage of normal condition.

3.2.1.2 Weight loss

The mature guava sample T_1 (grade A& grade B) kept in normal room temperature at 25 ºC, T_2 (grade 1 & grade 2) freezing temperature at 0ºC, and T_3 (grade 1 & grade 2) in refrigerated temperature at 1.6º C. Storage periods of the sample to the end stage of post-harvest life after the experiment started). Weight loss was observed between 2 days interval to the end stage of post-harvest life in optimum mature guava respectively.

Maximum weight loss (GA 10.20% & GB 9.86%) may be seen during normal storage condition of mature guava, followed by wt. loss (GA 3.41%& G B 6.46%) during refrigeration storage condition of T_3 sample and minimum wt. loss during freezing storage condition. it was seen that the maximum percentage of total weight loss of mature guava under post-harvest treatment was found in the sample T1 and minimum was in T_2. But post-harvest life was low of T_3 (grade B) & T_1 (Grade A&B) mature guava. This change in percentage of weight loss may be due to the change in the respiration rate, environmental factor (temperature, relative humidity, air etc.).

3.2.1.3 Color change during storage

Color change can be observed during storage of different condition.Green color was present first three days during storage of mature guava. Yellow color was present in the last stage of normal & refrigeration storage condition and olive color present in freezing storage condition with acceptable quality.

3.2.2 Physico-chemical properties

Moisture content of mature guava was 84.28%, ash contained was3.83%,TS contained was 15.72%,Vitamin C containedwas 118 mg/100gm andpH contained was 3.54.

3.3 Ripen Guava

Over-mature fruit (i.e., fruit harvested ≥ 11 weeks after fruit set), exhibited a shelf-life of 8 – 10 d; but in this case, hardening of the endocarp, shrinking of the peel and pulp from the endocarp and a rapid decline in bioactive and biochemical constituents, rendered the fruit useless for fresh consumption or for processing.

Table 6. Color changes of guava (mature) during storage

Date	Room temp. (T_1)		Freezing temp.(T_2)		Refrigeration temp. (T_3)	
	GA	GB	GA	GB	GA	GB
1st day	Green	Green	Green	Green	Green	Green
3rd day	Green	Green	Green	Green	Green	green
7th day	Yellowish Green	Yellowish Green	Green	Green	Light Green	yellowish
9th day	Yellow	Yellowish	Olive Green	Green	yellowish	yellowish
11th day	Yellow, spot	Yellow	Olive Green	Olive Green	Yellow	Yellow, spot
13th day	Yellow, spot	Yellow, spot	Olive	Olive	Yellow	Yellow, black spots
15th day	Black spots Rotten	Black spots Rotten	Olive	Olive	Yellow & spot	black spots, Rotten

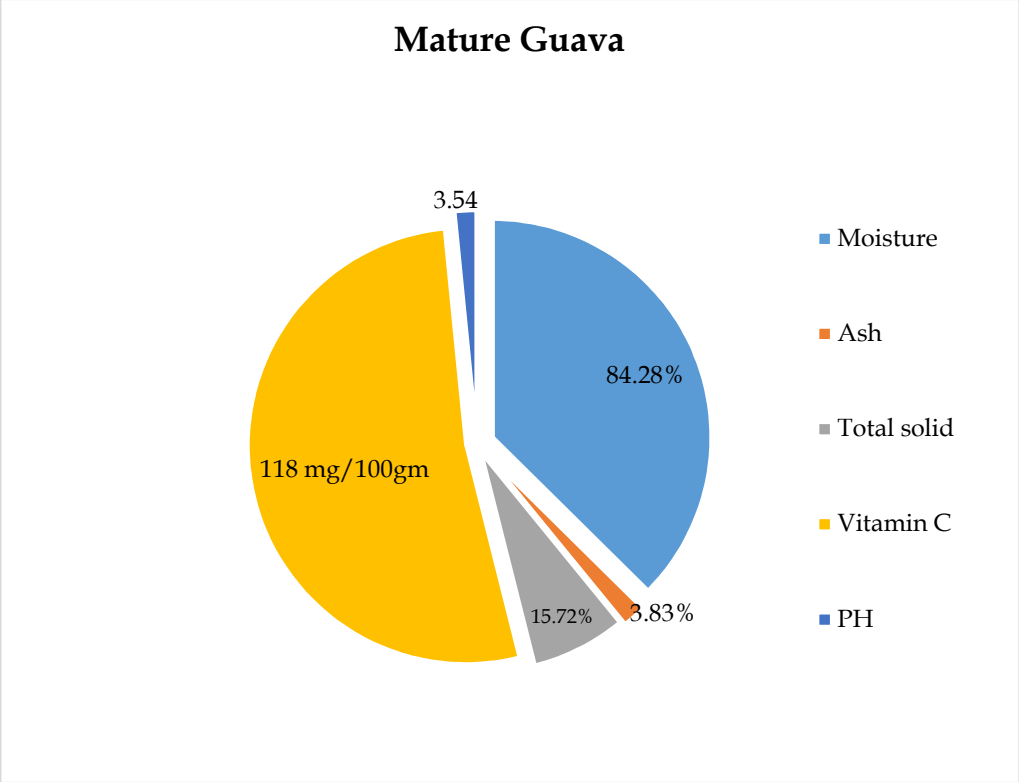

Fig. 2. Ash, moisture, total solid, pH and ascorbic acid content of mature guava

3.3.1 Physical properties

3.3.1.1 Shelf-life

All bags with fruits were weighted and put in ventilated carton box. Sample S_3 were stored in normal condition (room temperature) at 25°C, freezing condition at 0^0 C and in refrigeration condition at 1.6 ^{0} C with 90-95% relative humidity, the fruits were taken end of the shelf life to determine changes in quality during storage in different condition.

Table 7. Shelf-life of ripen guava

Ripen Guava	
Storage Condition	**Self-life (Days)**
Room temp. (T_1)	11
Freezing temp. (T_2)	17
Refrigeration temp. (T_3)	13

In the present study, Ripen Guava T_1 shows rapid deteriorations during normal storage condition in their bioactive and biochemical constituents by day-11 of storage. Mature guava T_2 showed highest post-harvest life (17 days) during storage of freezing condition & T_3 sample deteriorations after 11 days during storage of refrigeration condition.

3.3.1.2 Weight loss

The Ripen guava sample S_3 kept in normal room temperature 25ºC, in freezing temperature 0ºC and in refrigerated temperature 1. 4ºC. The experimental design was completely organized with three temperature treatments (25ºC, 0ºC and 1.6ºC) and storage periods (1-9 days after the experiment started). Weight loss was observed daily to the end stage of post-harvest life harvest in optimum ripen guava respectively.

High weight loss (15.54%) may be seen during normal storage condition of ripen guava, medium wt. loss (10.29%) during refrigeration storage condition and minimum wt. loss (1.62%) during freezing storage condition. In normal condition, post-harvest life of ripen guava S_3 is 11 days & in refrigeration, 13 days & in freezing 17 days with acceptable quality. It was seen that the maximum percentage of total weight loss of ripen guava under post-harvest treatment was found in the sample T_1 and minimum was in T_2. This change in percentage of weight loss may be due to the

change in the respiration rate, environmental factor (temp., relative humidity, air etc.) stages of maturity of immature guava and storage condition etc.

3.3.1.3 Color change during storage

In ripen guava fruits, yellow color may be present in end stage of every storage condition.

3.3.2 Physico-chemical properties

Figure represents that mature guava contain 4.54% ash, 84.34% moisture and 15.66% total solid, pH level 2.92 and ascorbic acid 76mg/100gm.

3.4 Comparison Analysis of Properties on the Basis of Parameters among the Different Maturity Stages of Guava

3.4.1 Storage stability (Shelf life)

The figure showed that, in immature and mature (grade A and grade B avarage) guava, the highest storage life was 13 days in both freezing and refrigeration temperature. Lowest shelf life was 11 days in room temperature. The highest post harvest storage life was 17 days was found in ripen guava during storage in freezing condition. Ripen guava also remains acceptable for 13 days in refrigeration condition & 11 days in room temperature. This study is related to the investigation of [7] as reported in the literature review.They studied on the extension of the shelf life of guava by individual packaging to assess the effectiveness of individual film in form of Shrink and Cling wrap on shelf life of guava. Individual wrapping reduced the magnitude of changes during storage.Film wrapping preserved freshness of wrapped fruits as they remained acceptable for whole storage time in contrast to control fruits which turned unacceptable by 15th day of storage. Shrink wrapping enhanced the shelf life by 10 days. [8] studies on post-harvest physiology and storage on tropical and subtropical fruits. His book deals with the post-harvest storage of all of the economically important tropical and subtropical fruits.

3.4.2 Physiological loss weight (PLW) of immature, mature and ripen guava

This graph showed that, physiological loss of weight (PLW) % was highest in room temperature for all three stages of maturity (18% in immature guava, 10.2% (grade A) and 9.86% (grade B) in mature guava, 15.54 in ripen guava). Weight loss was lowest in freezing temperature for mature guava (0.65% in grade A and 0.14% in grade B) as extra moisture might be added during freezing condition. Weight loss found 16.37% in immature and 1.62% in ripen guava during freezing condition. In refrigeration, weight loss was 15.16% in immature guava, 3.41% (grade A) and 6.46% (grade B) in mature guava and 10.29% in ripen guava.There is a similarity with [9].They said, physiological loss in weight (PLW) increased rather slowly in the beginning (0.67%), but at a faster pace later (3.72%) during low temperature storage irrespective of maturity stages.

By visual observation, it was seen that immature and mature guava in average turns it colors gradually (green>light green>yellowish green>yellow>yellow, black spots>black spot and wasted) during refrigeration and room temperature. But in freezing temperature, both immature and mature guava turns into olive green color. Green color lasts for 1st three days in immature and mature guava at all temperature treatment. Olive color was seen in last stage of T_2 which indicates that freezing treatment is the most beneficial to reserve the fruit quality. In ripen sample, yellow color lasted till end stages of T1, T_2, T_3 and black spots was common at last unacceptable stages.

3.4.3 Moisture content

Moisture percentage was found higher in ripen guava (84.34%) and lowest in immature guava (84%). These findings were similar to the findings of [10]. They conducted an experiment on biochemical and physical changes of four Guava cultivars-Ganib, Pakistani, Shambati and Shendi during growth and development. They found that moister content was increased significantly with fruit growth and development in all cultivars.

3.4.4 Ash content

Ash percentage was found higher in ripen guava (4.54%) and lowest in immature guava (3.81%).

3.5 pH Level

The pH level depends on the food, variety of food and the growing conditions such as the soil pH level. In this study, immature guava contains pH 4.52, Mature guava pH 3.54 and Ripen guava pH 2.92. The sequence wasimmature>mature>ripen guava.

Table 8. The percentages of total weight loss of guava (ripen) under different post-harvest temperature treatments with storage time

Date	Room temp. T_1(gm)	Freezing temp. T_2(gm)	Refrigeration temp. T_3 (gm)
1st day	52.101	65.109	50.293
3rd day	51.759	65.084	50.205
5th day	49.552	64.981	50.103
7th day	47.452	64.549	49.662
9th day	46.582	64.382	48.751
11th day	44.003	64.228	47.953
13th day	Rotten	64.150	45.120
15th day	Rotten	64.101	Rotten
17rh day	Rotten	64.053	Rotten
% of weight Loss	15.54	1.62	10.29

Table 9. Color changes of guava (ripen) during storage

Date	Room temp. (T_1)	Freezing temp. (T_2)	Refrigeration temp. (T_3)
1st day	yellow	Yellow	Yellow
3rd day	yellow	Yellow	Yellow
5th day	yellow	Yellow	Yellow
7th day	yellow	Yellow	Yellow
9th day	Yellow, spots	Yellow	Yellow
11th day	Yellow, black spot	Yellow	Yellow
13th day	Rotten	Yellow, light spot, wasted	Yellow, spot, wasted
15th day	Rotten	Yellow, spot, wasted	Rotten

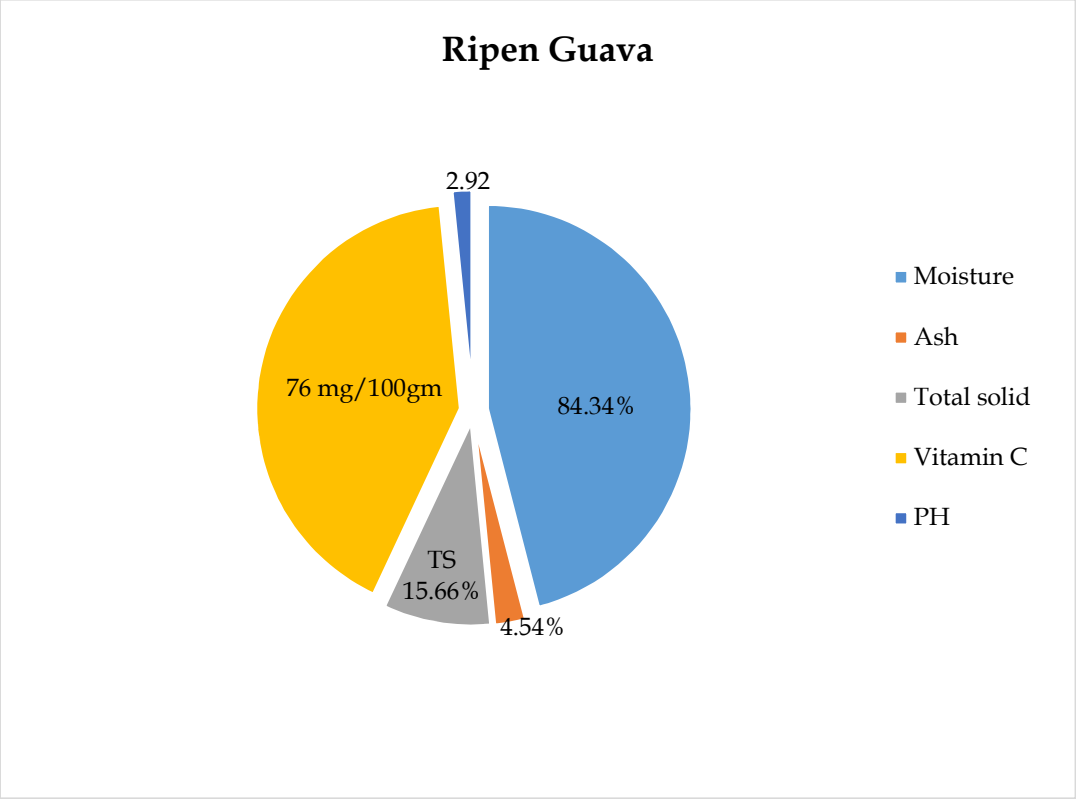

Fig. 3. Ash, moisture, total solid, pH and ascorbic acid content of ripen guava

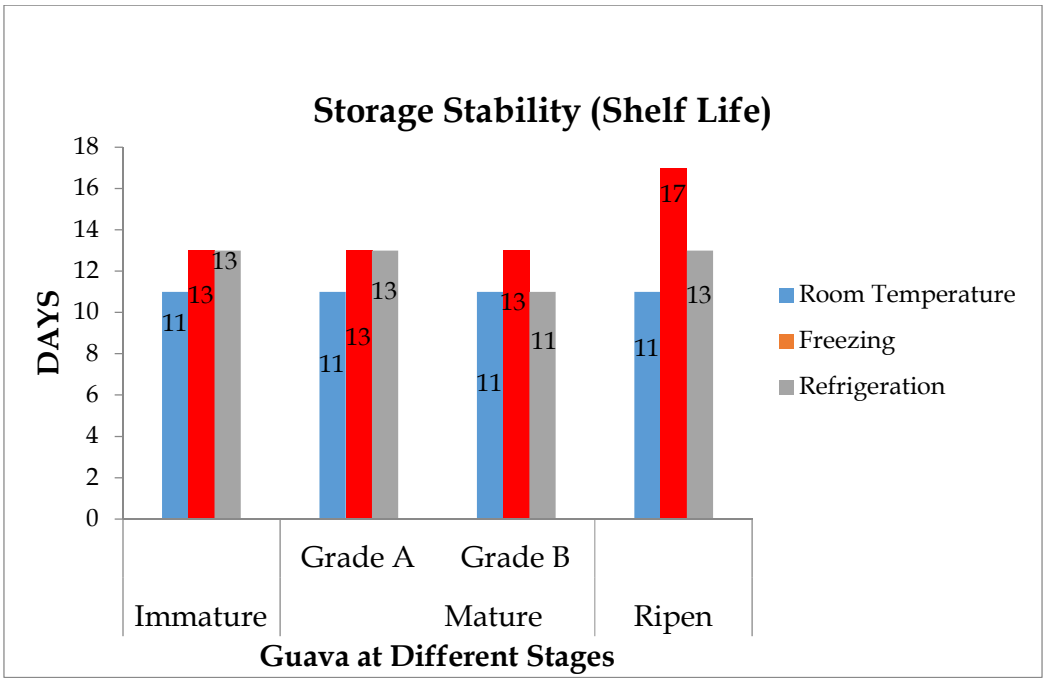

Fig. 4. Post harvest shelf life of immature, mature and ripen guava

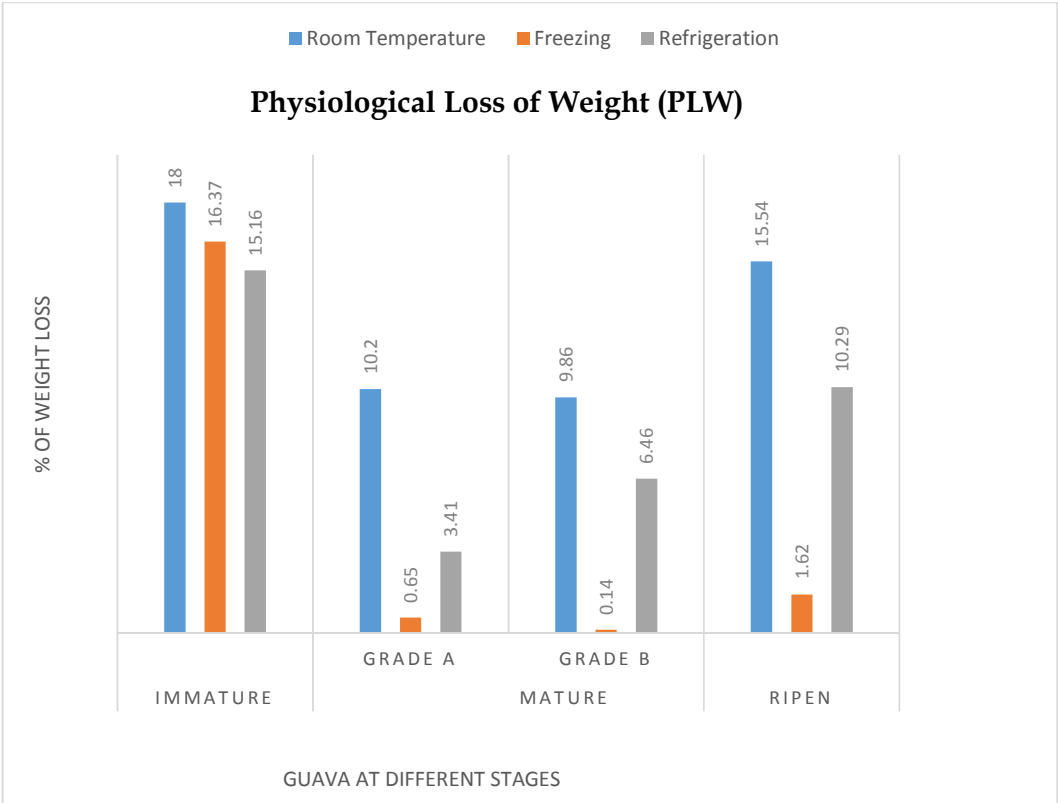

Fig. 5. Physiological loss of weight (PLW) of immature, mature and ripen guava

3.5.1 Total solid (TS)

The maximum total solid (15.79%) founded in immature guava followed by 15.72% in mature guava & minimum total solid (15. 66%) in ripen guava. TS percentage was the opposite to moisture content. The sequence was immature>mature>ripen guava.

Table 10. Moisture content of immature, mature and ripen guava

	Guava		
	Immature	**Mature**	**Ripen**
Moisture	84%	84.28%	84.34%

Table 11. Ash content of immature, mature and ripen guava

	Guava		
	Immature	**Mature**	**Ripen**
Ash	3.81%	3.83%	4.54%

Table 12. pH level of immature, mature and ripen guava

	Guava		
	Immature	**Mature**	**Ripen**
pH	4.52	3.54	2.92

3.5.2 Ascorbic acid (vitamin C) content

The highest ascorbic acid content was found in mature stage (118 mg/100gm) and 86mg/100gm, 76 mg/100gm in immature and ripen stage respectively. The sequence was mature> immature>ripen guava.

In this graphical show, the ascorbic acid percentage was suddenly went to the peak level in mature stage and gradually falled to ripen stage. It indicating that mature guava was the source of highest vitamin C. Vitamin C range was about (299 mg/100 g) [11]. These findings were in agreement with the findings of [12]. They

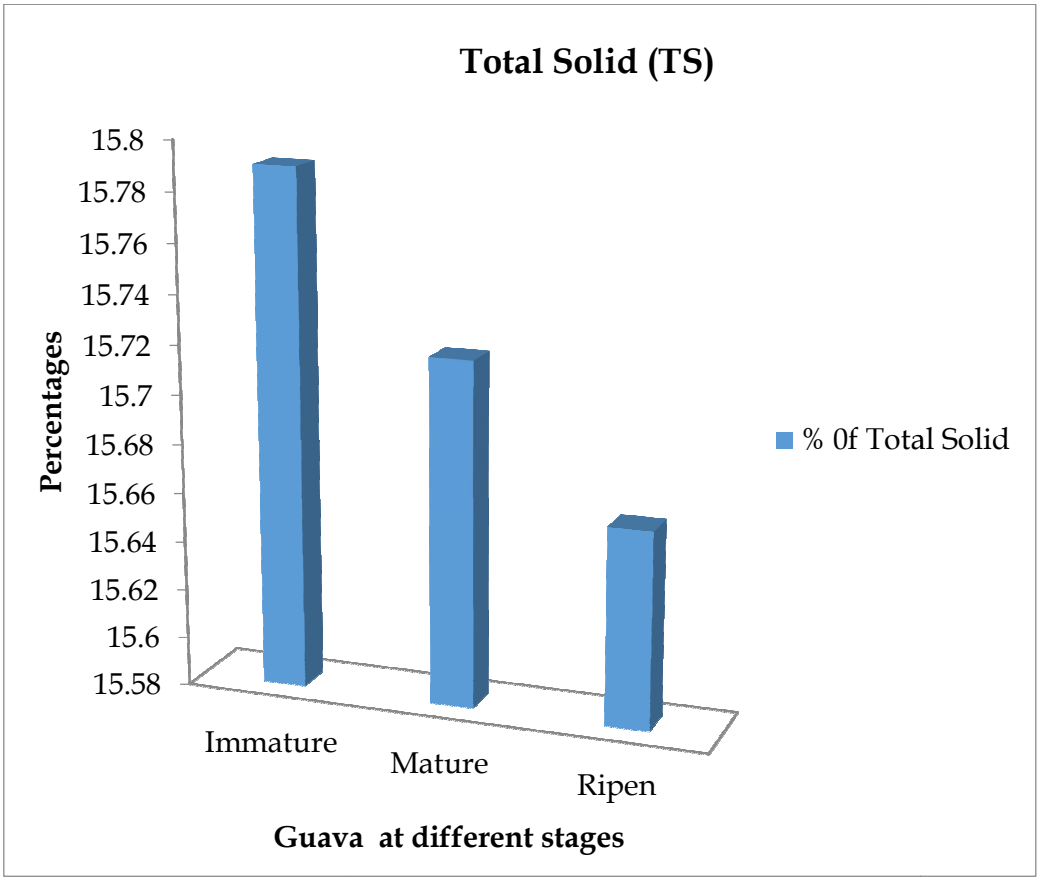

Fig. 6. Percentage of TS in immature, mature and ripen guava

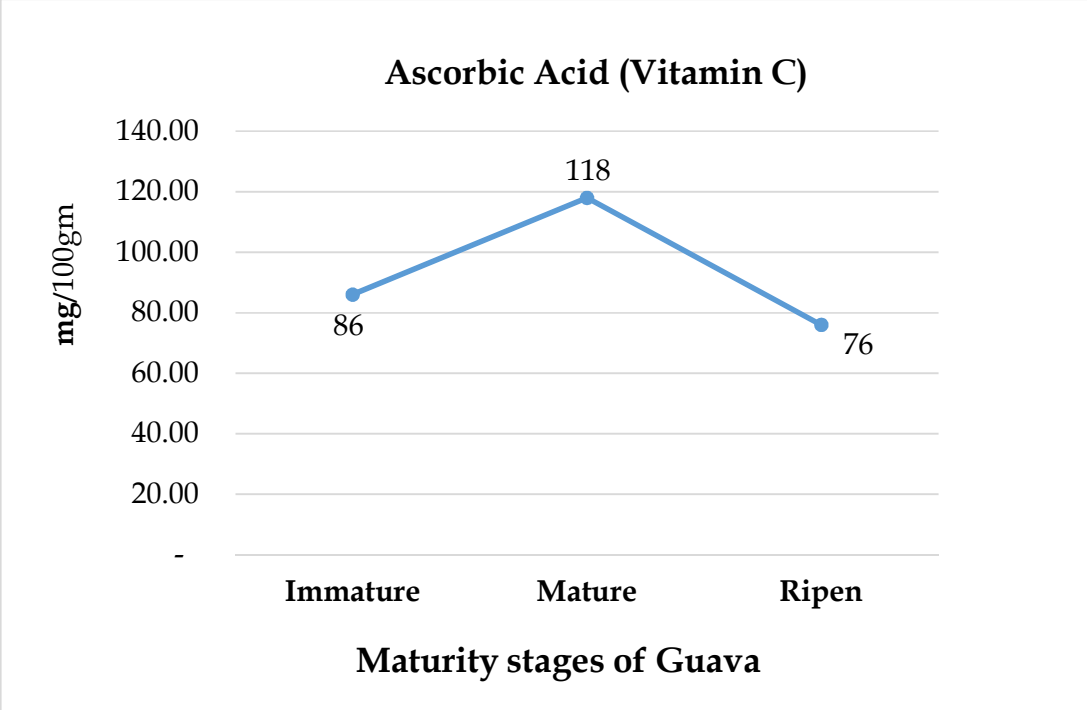

Fig. 7. Ascorbic acid (vitamin C) content in immature, mature and ripen guava

reviewed that ascorbic acid content was at its maximum level at the mature-green stage and declines as the fruit ripens in both white and pink guavas and may also be a function of postharvest handling. [10] also stated that ascorbic acid was increased significantly with fruit maturity. [13] also found the similar result with the cultivars sardar, Allahabad Safeda and Banarasi Surkha. [14] stated that vitamin C was increased in all the cultivars during ripening and decreased during senescence. According to [15], the guava fruit contain 260mg vitamin C per 100g fruit, which differed with the variety, stages of maturity, ripening and season.

5. CONCLUSION

'Big things come in small packages', such fruit is the guava. The fruit guava are available as seasonal surplus during certain part of the year and are wasted in large quantities due to absence of post-harvest facilities and know-how for proper handling, distribution and storage. Physiological and biochemical changes of the fruit are of major concern for understanding metabolic processes.Moreover, they are of importance in determining commercial practices and post-harvest requirements. Though it is not possible to improve the quality of produce after harvest, but it is possible to slow down the rate of undesirable changes. The maintenance of physical and chemical attributes that confer quality to harvested fruits depends mainly on harvest maturity and partly upon the ability to impose conditions that minimize changes of these attributes. In Bangladesh, every year a large amount of guava is produced and get rotten a lot because the fresh guava has short shelf life of one week because of high moisture content. The post-harvest losses occur to the tune of about 22%. However, the chemical studies are generally detection studies. Guava is produced in Bangladesh in a lot of amount especially in rainy season but there are relatively expensive storage techniques for home level non-commercial people. The conclusion of our current study suggests freezing treatment as the cheapest technique of storage.Mature guava contains most vit C among three stages.As guava is an alternative and low price vit C containing fruit than other vit C rich fruits low income people may be able to have the important nutrients markedly vitamin C.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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