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Effect of Edible Coating on Quality and Marketable Life of Fresh Cut Guava Fruit

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Abstract

Guava (*Psidium guajava* L) is a major fruit having high nutritional value. Bangladesh is one of the leading producers of guava now. The fruits go to loss in postharvest due to its proper processing technology and also people do not familiar with its consumption except fresh one. Hence, adoption of minimal processing technique will be a possible solution to overcome these problems. Therefore, the present study was undertaken to evaluate the different coating materials on quality and prolong the marketable life of the fresh cut guava fruit. The experiment was laid out in complete randomize design (CRD) with three replications and ten treatments viz. T_1= 2.0% potato starch+ normal H_2O, T_2= 2.0% cassava starch+ normal H_2O, T_3= 2.0% potato starch+ hot H_2O, T_4= 2.0% cassava starch+ hot H_2O, T_5= Control, T_6= 2.0 % endure fresh 370 (commercial coating), T_7= 2.0 % endure fresh 214 (commercial coating), T_8= 2.0 % endure fresh 9000 (commercial coating), T_9= Corn starch+ normal H_2O and T_{10}= 2.0 % corn starch+ hot water. The natural coating was extracted from the potato and cassava and then it was applied to the fresh cut guava fruit. After treated, the fresh cut guava was packed into PET boxes and kept in refrigerator at 5±1°C with 95±1% relative humidity. Results revealed that fresh cut guava fruit coating with 2.0% potato starch+ normal H_2O (T_1) and 2.0% cassava starch+ normal H_2O (T_2) performed best effectiveness by reducing a significant amount of physiological loss in weight (PLW) and moisture loss and retaining original color and freshness than the commercial edible coating. The marketable life of the fresh cut guava coating with potato (T_1) and cassava starch (T_2) could be extended 3 to 4 days more than the commercial edible coating. This technology may be helpful to the minimal processors to preserve their produce as fresh 3 to 4 days more than the traditional process without any hassle and quality deteriorate.

Key words: PLW, Color, energy, Freshness, marketable life, sensory attributes

Introduction

Guava (*Psidium guajava* L) is now cultivated in all parts of Bangladesh. The tree is almost naturalized in the country and it is common to find this spreading shrub laden with aromatic fruits in some remote corner. The guava fruit is known by Bengali as peyara. It excels most other fruit crops in productivity, hardness, adaptability, and vitamin C content. The fruit is one of the richest sources of vitamin C. It contains four to 10 times more vitamin C than some citrus fruits do. The guava contains very little vitamin A or carotene. However, it is fairly rich in most other mineral nutrients. The vitamin C value of the fruits increases with maturity and is maximum when the fruit is fully ripe. However, the vitamin content declines when the fruit is overripe or soft. The guava contains numerous pale colored seeds which are quite rich in aromatic oil (14%) which is orange yellow in color.

The market for fresh cut fruits has rapidly grown in recent years. Optimization of minimal processing technique for the bulky guava in its tender form could be highly advantageous in making the commodity convenient for handling and transport. According to Ramli (2017) minimal processing is a replaceable traditional preservation method as it helps to produce products with good sensorial as well as nutritional quality. The foodservice industries are also focusing on getting more pre-prepared ingredients to minimize handling and to reduce operating cost (Ahvenainen, 1996). International Fresh-cut Produce Association (IFPA) defines fresh-cut products as fruit or vegetables that have been trimmed and/or peeled and/or cut into 100% usable product that is bagged or pre-packaged to offer consumers high nutrition, convenience, and flavor while still maintaining its freshness (Lamikanra, 2002).

There is a requisite to development of technology or process for guava as its production is increasing rapidly. The consumers also demanding fresh cut ready food to their dietary table as the food processing and cooking is time consuming. Current research shown, different preservatives such as firming and anti-browning agents with refrigerated storage conditions are using for minimal processing of other fresh cut fruit. But limiting study is available to process the guava fruit as fresh cut with its prolonging shelf life. After harvest, most of the fruits and vegetable goes to respiration and transpiration process naturally. The respiration and transpiration process occur the moisture loss of the fresh produce and finally contribute to reduce the postharvest life of the fresh produces.

Starch has potential to be used as an edible coating for fresh-cut fruits as it contains various polysaccharides. An edible coating can be used as an alternative to modified atmosphere packaging to progress the shelf life of fresh-cut fruits by reducing respiration and transpiration loss, quality changes and quality loss during storage (Rojas-Grau et al., 2009a). An edible coating can serve as a barrier to moisture migration, gas diffusion and microbial invasion to maintain the quality of fresh-cut fruits. It can be extracted from the fresh potato and cassava within the range from 12.0 to 18.54% and 25.01-28.00 % respectively. The country (Bangladesh) produces over production of potato and still now more than 35 lakh MT potatoes is surplus (BBS, 2019). As it is a good source of starch, so its starch could be used as surface coating instead of commercially graded coating. But still now its application as edible coating material to guava fresh cut fruit for extending the marketable life has not been explored. Hence, the objectives of this study were to investigate the effect of starch as an edible coating and compare with different commercial edible coating on the marketable life, physical characteristics and sensory acceptance of the fresh-cut guava fruit.

Hence, the objective of current study is to optimize the minimal processing variables viz. combination of starch, preservative, storage condition for tender guava and for predicting the effect of treatments on the quality and shelf life of minimally processed tender guava.

Materials and Method

Physiologically matured guava fruits were collected from the local farmers of Gazipur city, Bangladesh. After harvest, the fruits were precooled to remove field heat. Then the fruits were sorted and graded based on the pest, disease infestation, uniform size and shape. The fruits were then washed thoroughly with clean water. Then its' cut into angular sizes using stainless steel knife. The following treatments were followed. After treated, the fruits were kept to remove the surface water. Then initial weight of the sliced fresh cut guava was recorded and then packed into PET boxes for further observations.

Treatments

T_1= 2.0% potato starch+ normal H_2O

T2= 2.0% cassava starch+ normal H_2O

T_3= 2.0% potato starch+ hot H_2O

T_4= 2.0% cassava starch+ hot H_2O

T_5= Control

T_6= 2.0 % endure fresh 370 (commercial coating)

T_7= 2.0 % endure fresh 214 (commercial coating)

T_8= 2.0 % endure fresh 9000 (commercial coating)

T_9= Corn starch+ normal H_2O

T_{10}= 2.0 % corn starch+ hot water

Texture analysis

Texture analysis was done using cross-sectional prove by a Texture Analyzer TA.XT plus (Stable Micro System, Godalming, UK) by back extrusion method. The test mode compression was used to determine the instrument working parameters with test speed at 1mm/s, distance 2.50 cm. The analysis of the data was performed by Texture Exponent Lite version 6.1.14.0 software (Stable Micro System, Godalming, UK) to determine the rupture force and it expressed as N.

Vitamin-C content

The biochemical traits of the fresh cut guava in relations to moisture and vitamin-C content were recorded according to the procedure described by Ranganna (1995).

Physiological loss in weight (PLW)(%)

It was determined by periodical weighing of fresh cut guava fruit using digital electronic balance and expressed as percentage of original weight. Damaged sliced were also included with it. The weight loss was calculated as following formula of Kurubar (2007).

$$PLW\ (\%) = \frac{\mathrm{IW} - \mathrm{FW}}{\mathrm{IW}} x100$$

Here,
WL = Weight loss of fresh cut guava fruit
IW = Initial weight of fresh cut guava fruit
FW = Final weight of fresh cut guava fruit

Color measurement

At initial day of storage and day after storage, the color of the fresh cut guava fruit was assessed with a Chroma Meter (Model CR-400, Minolta Corp. Japan). International Commission on Illumination (CIE) lightness (L*), redness (*a), yellowness (*b), chroma (c*) and hue angle (h*) values were documented using D65 illuminates and a 10E standard viewer as an orientation method. The equipment was calibrated on a standard white tile. Then it was assimilated to measure the value of L*, *a, *b, c* and h* and were replicated three times for each treatment.

Marketable life (day)

Marketable life of the fresh cut guava was recorded on daily basis until the slices spoilage level, damaging, shriveling etc. reaches up to 5.0 %, which is considered as maximum marketable life limit.

Sensory evaluation

The sensory attributes were performed following the procedure of Joshi (2006). It was performed using a 9-point hedonic scale, i.e. 9= Like extremely, 8= like very much, 7= Like moderately, 6= Like slightly, 5= Neither like or dislike, 4= Dislike slightly, 3= Dislike moderately, 2= Dislike very much and 1=Dislike extremely. A judgment panel was formed by the thirty expert members from the BARI inter-divisional Scientists to evaluate their appearance, flavor, texture, mouth feel, aroma and overall acceptability. The score obtained by the panelist was analyzed by statistical analysis.

Statistical analysis

All data was expressed in duplicate as means ± standard deviation. One-way ANOVA with post-hoc using Turkey Multiple Comparison Test were performed to analyze the data. The connotation was defined at the 95% confidence level. Statistical analysis and data processing was performed using software SPSS 17.0 (IBM INC., New York).

Results and Discussion

Texture analysis of the fresh cut guava

The fresh cut guava hardness depends on the freshness and texture of the fruit. Therefore, the values of rupture force (FR) were measured in order to assess the treated fresh cut guava hardness (Fig.1). The results of the rupture force for the treatment T_1, T_2, T_3, T_4, T_5, $T_{6,}$$T_7$, $T_{8,}$ T_9 and T_{10} were recorded as 58.18 N, 58.94 N, 57.93 N, 58.89 N, 58.99 N, 58.44 N, 58.37 N, 58.45N, 58.59 N and 58.37 N respectively. After storage, the FR was decreased and calculated as 45.37 N, 45.44 N, 45.31 N, 45.33 N, 44.06 N, 39.32 N, 45.21 N, 44.59 N, 44.39 N and 44.15 N respectively. However, the lowest FR was recorded in control samples T_5 (44.06 N), T_6 (39.32

N) and the commercial graded coating T6 (39.32 N), T7 (45.21 N) and T8 (44.59 N). Results indicate that the potato and cassava starch coating (both normal and hot H_2O condition) retained maximum FR (45.31-45.44 N) than other edible coating. The highest FR was retained by the treatment T_2 (2.0% cassava starch+ Normal water) as compared to other edible coating.

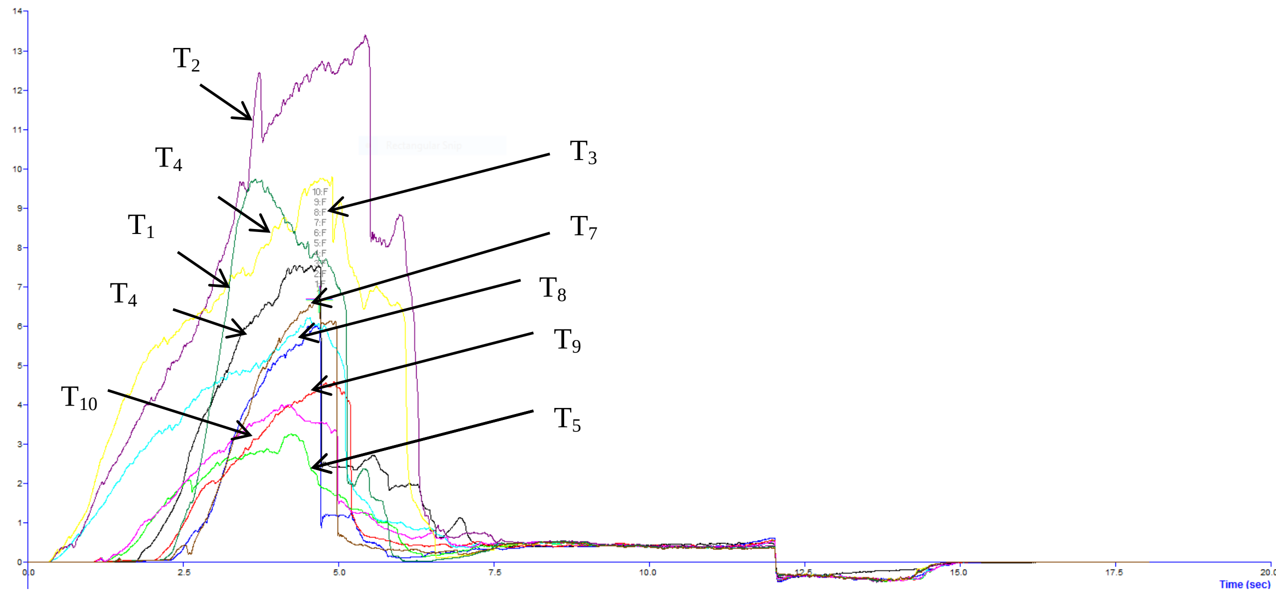

Fig.1. Texture of fresh cut guava after 7 days of storage

Physiological loss in weight (%), Moisture content (%) and energy of the fresh cut guava fruit

Physiological loss in weight (PLW) of fresh cut guava fruit

PLW of the fresh cut guava fruits increased gradually with the advancement of storage periods (Table 1). A statistically significant difference was observed in PLW among the different edible coating materials. Fresh cut guava fruit coating with 2.0 % potato starch+ normal water (T_1) and 2.0 % cassava starch+ normal water (T_2) had the lowest ($p<0.01$) PLW entire the storage periods. The highest PLW was recorded in control fruits (T_5; without coating) followed by other coating materials. The higher PLW may be due to more water loss during storage (Table 1) that contributed to turn shrinkage and dry skin (Molla et al. 2017). Water is the main component of fresh fruits and vegetables; therefore, reduction of its loss from the commodity is the most critical requirement for maintenance of postharvest quality attributes (Salami et al., 2010). Hence the rate of PLW was more obvious and fresh cut guava fruit rapidly loses its attractive green color. Thus the more PLW finally contributed to obtain the lower marketable life of the fresh cut guava (Fig.3).

Moisture content (%) of the fresh cut guava fruit

Moisture content (%) of the fresh cut guava fruit coating with potato and cassava starch was recorded as from 86.36-86.69 % and 86.52-86.75 % after 3 days of storage (Table 1) but after 7 days of storage, the moisture content was from 86.51-86.71% and 86.61-87.12 % respectively. The results indicate that moisture content of all the coated fresh cut guava were significantly increased with the progression of storage periods (Table 1). The increasing trend in moisture content could be due to use of coating materials and plastic PET box that may be contributed to inhibit the loss of moisture by reducing evaporation process. The higher moisture content loss was found in control sample (T_5; without coating) and the loss was significantly increased with increasing storage periods. The lower moisture loss obtained by the starch coating (both potato and cassava starch) influenced the lower PLW of the fresh cut guava fruit stored at 5±1ºC. Hence, the fresh cut guava coating with 2.0 % potato starch+ normal water (T_1) and 2.0 % cassava starch+ normal water (T_2) contributed to retain more water by reducing the respiration loss and excessive PLW.

Energy content (Kcal/g) of the fresh cut guava fruit

The energy content of the fresh cut guava fruit increased with the increase of storage periods (Table 1). The highest energy was found in commercially graded coating treatment ($T_{6,}$ T_7 and T_8) whereas the lowest was recorded in starch coating treatment ($T_{1,}$ $T_{2,}$ T_4 and T_7). As a reason, the starch coated fresh cut guava fruit contained high amount of moisture content (as it reduces the respiration loss; although data is not shown here) than the commercial graded coating materials (Table 1). The increasing moisture content provided lower energy value of the fresh cut guava fruit. However, the moisture content have a substantial impact on retain of energy value (Lu et al., 2019).

Table 1. Effect of edible coating on PLW (%), moisture content (%) and energy (Kcal/g) of the fresh cut guava fruit

Treatment	PLW (%)		Moisture content (%)		Energy (Kcal/g)	
	After 3 days	After 7 days	After 3 days	After 7 days	After 3 days	After 7 days
T_1	1.15±0.72c	2.12±0.90bc	86.69±0.56a	86.71±0.49ab	3992.23±0.99g	3993.23±0.99h
T_2	1.14±0.22c	1.31±0.16c	86.75±0.45a	87.12±0.17a	3334.39±0.99h	3335.26±1.19i
T_3	2.08±0.01bc	2.61±0.38bc	86.36±0.18a	86.51±0.21ab	4005.94±0.97f	4006.47±0.82g
T_4	2.26±0.37bc	2.86±0.72bc	86.52±0.37a	86.61±0.73ab	4045.63±0.98e	4046.53±0.93f
T_5	5.02±0.98a	7.02±2.29a	84.00±0.49c	82.28±1.22c	4269.64±0.98	4270.20±0.88a
T_6	3.42±0.38ab	4.65±1.05ab	85.98±0.53a	86.67±0.76ab	4060.12±1.00d	4061.02±1.00e
T_7	1.93±0.04bc	2.21±0.06bc	86.32±0.63a	87.08±0.66ab	4114.32±1.02a	4115.08±0.97b
T_8	2.74±0.99bc	3.07±0.68bc	84.69±1.00bc	85.45±0.16ab	4109.66±1.00b	4110.11±0.95c
T_9	3.73±1.47ab	4.39±1.45ab	84.15±0.42bc	85.18±1.01ab	4047.60±1.00e	4048.21±0.85f
T_{10}	2.49±0.087bc	3.15±0.53bc	84.39±0.61bc	85.30±1.26ab	4068.53±1.01c	4069.28±0.75d

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b, c, d, e, f, g, h, i indicate significant result ($p<0.05$).

Color changes of the fresh cut guava fruit

Color is one of the important quality attributes for consumer acceptability of foods, particularly for fresh cut fruits and vegetables (Lim et al., 2010). At initial day of storage and day after storage, L* values were non-significantly differed and the values were increased with the advancement of storage periods for the treatment T_1, T_2, T_3, T_4 and T_7 (Table 2). The L* values for the treatment T_5, T_6, T_8, T_9 and T_{10} were decreased with the advancement of storage periods. The low L* values indicate a dark color and are mainly associated with non-enzymatic browning reactions (Dueik et al., 2010). The increased L* values may be associated with increasing marketable life of the treatment T_1, T_2, T_3, T_4 and T_7 (Fig.3). High amount of –a* values indicate the greenness of the fruit. At initial day of storage and after storage, although the –a* values were not significantly differed but the maximum values were found in treatment T_1 and T_2. The –a* values were decreased with the advancement of storage periods indicate that the fruit were turned to loss it greenish color than the initial color. The value of chroma (c*) was not significantly differed over the storage periods for all treatments. But the increased values were observed up to 7 days of storage. This would mean that the final chroma contained in fresh cut guava fruits coating with 2.0 % potato starch+ normal water (T_1) and 2.0 % cassava starch+

normal water (T_2) and stored at 5±1ºC retained the original color of the fruits. These results are in agreement with Semeerbabu et al. (2007). Results showed that hue angle (h*) was statistically insignificant in all treatments at on the day of storage and entire the storage. But the h* value slightly decreased up to 7 days of storage (Table 2).

Table 2. Effect of edible coating on color changes of the fresh cut guava fruit at different storage periods

Treatment	Color on the day of storage					Color after storage (7 days)				
	L*	a*(-)	b*	c*	h*	L*	a*(-)	b*	c*	h*
T_1	65.35± 4.17	18.20± 0.81	31.41± 0.79	34.63± 2.36	119.71± 0.92	65.69 ±8.55	17.90± 0.99b	32.95± 1.62	37.16± 1.48	118.58± 1.41a
T_2	63.19± 5.10	18.11± 1.48	29.95± 2.41	35.64± 2.80	118.26± 4.11	65.46± 8.81	17.59± 0.71b	32.59± 4.91	37.45± 4.63	116.58± 3.96a
T_3	60.57± 3.92	17.23± 0.83	28.06± 1.82	34.08± 2.20	120.37± 1.16	64.00± 8.24	14.97± 2.21ab	31.43± 3.38	35.38± 1.23	116.71± 4.58a
T_4	67.13± 3.62	16.16± 1.37	30.93± 0.33	35.37± 2.09	118.29± 1.30	67.42± 1.57	16.52± 0.80ab	35.50± 0.53	39.24± 0.70	116.33± 1.11a
T_5	70.46± 9.15	16.95± 0.95	31.08± 0.88	34.72± 1.63	119.96± 0.85	67.57± 4.57	16.86± 1.22ab	33.02± 2.82	35.84± 3.25	117.44± 1.27a
T_6	68.04± 2.97	17.23± 1.21	31.58± 1.72	35.35± 1.82	118.42± 1.10	66.72± 1.01	15.38± 1.36ab	33.62± 1.28	36.23± 1.42	99.22± 2.99b
T_7	70.42± 2.25	16.84± 3.51	31.08± 1.94	37.59± 0.46	119.60± 0.81	70.82± 3.20	16.16± 1.06ab	33.38± 0.91	37.90± 0.22	117.66± 1.06a
T_8	62.30± 2.86	16.20± 1.40	29.31± 1.88	33.08± 1.74	118.03± 0.52	60.94± 3.16	13.85± 0.13a	30.40± 2.34	34.10± 2.21	115.34± 1.40a
T_9	67.70± 4.03	17.44± 0.43	30.65± 1.07	35.49± 0.46	119.16± 0.95	66.98± 4.52	17.01± 1.89ab	33.02± 2.26	37.30± 3.01	117.18± 0.94a
T_{10}	71.66± 6.56	17.60± 0.77	32.07± 1.71	36.61± 1.00	119.47± 2.08	70.77± 7.32	16.51± 1.20ab	32.53± 1.18	36.61± 1.01	117.23± 2.57a

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b indicate significant result ($p<0.05$). No letter means no significant difference.

Vitamin-C content of fresh cut guava fruit

Fig.3 represents the vitamin-C content of the fresh cut guava fruit after 7 days of storage. Results revealed that the highest vitamin-C content was found in fresh guava fruit. After 7 days of storage, the coated and uncoated treatments showed a reduction in the vitamin-C content due to loss during processing as well as during storage through leaching, oxidation and enzymatic degradation (Lee and Kader, 2000). Among the coated samples, the hot water coated sample was found to have lower vitamin-C content than the normal water coated and control samples. The higher presence of vitamin-C content was found in 2.0 % potato starch+ normal water (T_1) and 2.0 % cassava starch+ normal water (T_2) than commercial edible coated samples. The lower presence of vitamin-C content in commercial coated samples might be due to oxidation and metabolic reaction with ingredients of the commercial coating materials during storage.

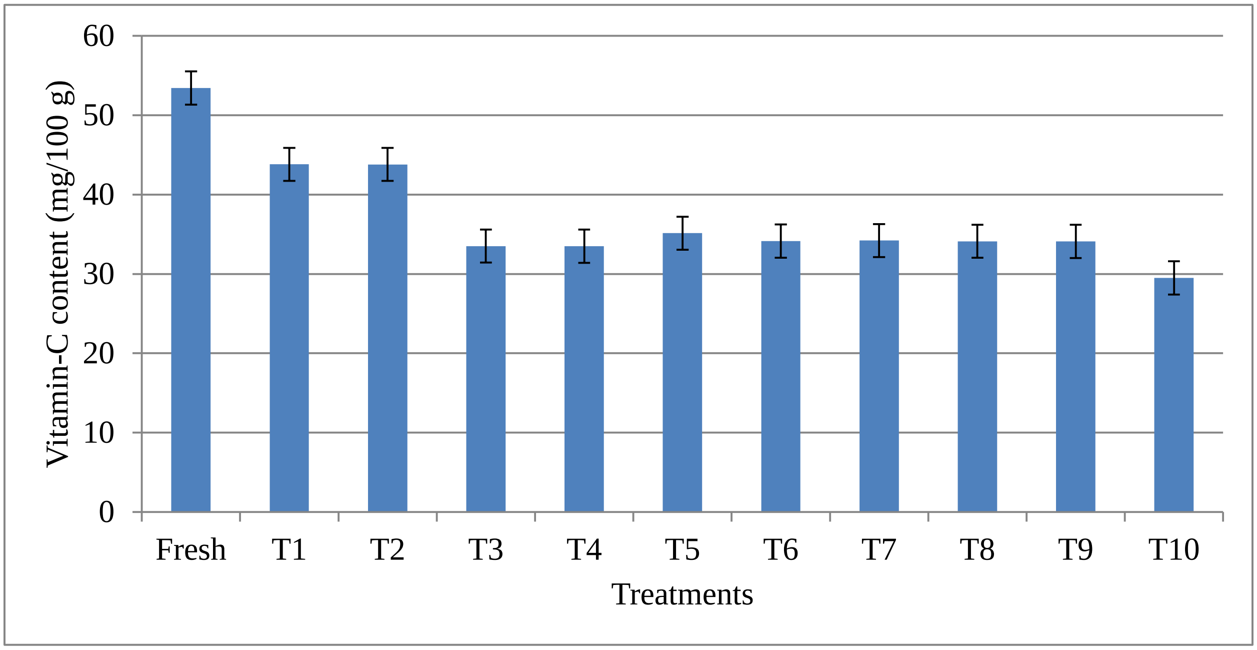

Fig.2. Effect of different coatings on vitamin-C content of fresh cut guava after 7 days storage

Sensory evaluation of fresh cut guava fruit after storage

The sensory evaluation for different treatments was done based 9-point hedonic scale and shown in Table 3. The highest score was obtained by the expert judgment in treatment T_2 terms of appearance, flavor, texture, mouth feel, aroma and overall acceptability. Most of the expert panelist opined that treatment T_5, T_6 and T_8 contained odd flavor, poor taste and lower texture. After storage, control T_5 was not preferred by the panelist in order to existence of odd flavor and fungal activities. All of the expert panelist also liked T_1, T_3 and T_4 due to their attractive appearances and marketable life. However, based on the perception of the panelist and marketable life, fresh cut guava fruit coating with 2.0 % potato starch+ normal water (T_1) and 2.0 % cassava starch+ normal water (T_2) selected as a best coating materials for prolonging the marketable life and quality of fresh cut guava fruit.

Table 3. Sensory evaluation of the edible coating treated fresh cut guava fruits

Treatment	Appearance	Flavor	Texture	Mouth feel	Aroma	Overall acceptability
T_1	8.00±0.66a	7.20±0.78a	6.50±0.52a	7.30±0.67a	6.79±0.84a	7.28±0.29a
T_2	7.40±0.96ab	7.50±1.08a	7.50±1.26a	7.40±1.07a	6.80±1.39a	7.32±0.98a
T_3	5.40±1.07cd	6.70±0.94ab	6.60±0.96a	6.40±1.07ab	5.70±1.41ab	6.96±0.71b
T_4	5.10±0.99d	5.10±0.99cd	4.90±1.19b	5.30±0.82bc	5.44±0.96ab	5.16±0.63de
T_5	5.10±0.73d	4.80±1.13d	4.90±0.87b	4.50±0.97c	4.60±1.42b	4.76±0.86e
T_6	6.40±1.07bc	6.60±1.07abc	6.40±1.17ab	6.30±1.05ab	5.89±1.10ab	6.32±0.84c
T_7	6.16±0.69ab	5.40±1.83bcd	6.60±1.50a	5.40±1.42bc	7.10±1.91a	5.84±0.68cd
T_8	5.11±0.99d	5.13±0.99cd	4.87±1.19b	5.33±0.82bc	5.40±0.96ab	5.16±0.63de
T_9	5.13±0.73d	4.85±1.13d	4.92±0.87b	4.45±0.97c	4.71±1.42b	4.78±0.86e
T_{10}	6.41±1.07bc	6.63±1.07abc	6.43±1.17ab	6.33±1.05ab	5.90±1.10ab	6.02±0.84d

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b, c, d indicates significant result ($p<0.05$).

Marketable life of fresh cut guava

The marketable life of fresh cut guava fruit decreased with the advancement of storage periods (Fig.3). The maximum marketable life was recorded in fresh cut guava treated with 2.0 % potato starch + normal water (T_2) and 2.0 % cassava starch + normal water (T_2) and stored at 5±1°C compared to fruits stored at ambient condition. The lowest marketable life was recorded in control fresh cut guava fruit. Among the coating materials, the lowest marketable life was found in fresh cut guava fruit coating with 2.0 % endure fresh 9000 (T_8), Corn starch+ normal H_2O (T_9) and 2.0 % corn starch+ hot water (T_{10}).

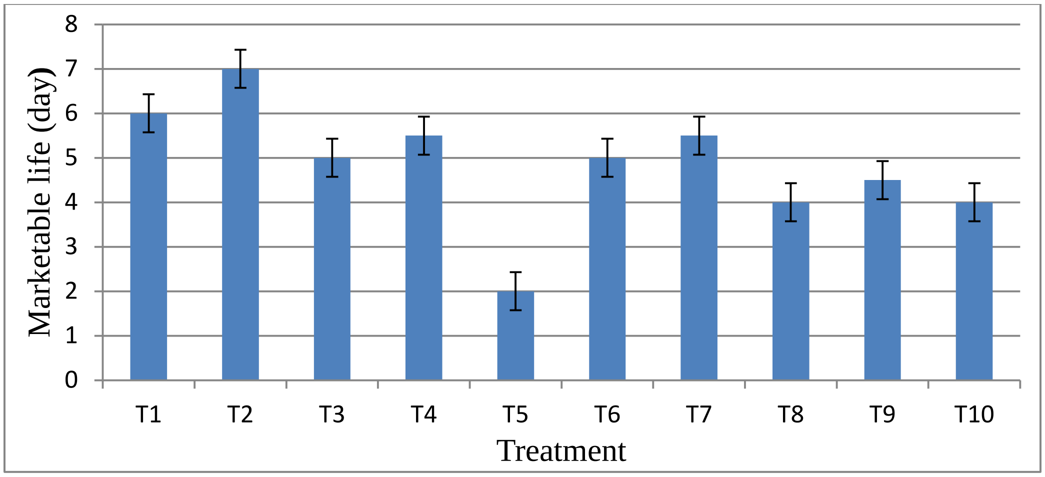

Fig.3. Marketable life of fresh cut guava fruit coating with different coating materials

Conclusion

The treatments for minimally processed fresh cut tender guava fruits were carried out under refrigerated conditions at 5±1°C using different coating materials. Results reveal that treatment T_1 (2.0% potato starch+ normal H_2O) and T_2 (2.0% cassava starch+ normal H_2O) showed best effectiveness by reduction a significant amount of PLW and moisture loss. The original color and freshness also retained by the potato and cassava starch coating than the commercial edible coating of the fresh cut guava fruit. The fresh cut guava coating with cassava and potato starch also gained the highest overall acceptance score by the panelists. In addition, the fruit coating with cassava starch was found to be more effective than the potato starch in maintaining the PLW, color and moisture loss. However, the marketable life of the fresh cut guava coating with potato and cassava starch could be extended 3 to 4 days more than the commercial edible coating. This technology could be helpful for the minimal processors to preserve their produce as fresh 3 to 4 days more than the traditional process without any hassle and quality deteriorate.

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References

Ahvenainen, R. 1996. New approaches in improving the shelf life of minimally processed fruits and vegetables. Food science and Technol. 71:171-189.

BBS. 2019. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics, Statistics and Information Division, Ministry of Planning, Government of the Peoples Republic of Bangladesh, Dhaka. PP. 200-233.

Dueik, V., Robert, P., Bouchon, P. 2010. Vacuum frying reduces oil uptake and improves the quality parameters of carrot crisps. Food Chem. 119(3):1143–9.

Kurubar, A.R. 2007. Studies on integrated nutrient and postharvest management of fig (Ficus carica L.). Ph.D. Thesis, Department of Horticulture, College of Agriculture, Dharwad University of Agricultural Sciences, Dharwad, India.

Lamikanra, O. 2002. Enzymatic Effects on Flavor and Texture of Fresh-cut Fruits and Vegetables. In book: Fresh-Cut Fruits and Vegetables. Science, Technol. and Market. CRC Press, Boca Raton.

Lim, H.S., Ghafoor, K., Park, S.H., Hwang, S.Y., Park, J. 2010. Quality and antioxidant properties of yellow layer cake containing Korean turmeric (Curcuma longa L.) powder. J. Food Nutr. Res. 49:123-133.

Lu, A., Hu, S., Li, M., Duan, T., Li, B., Chang, X. 2019. Impact of moisture content on the dynamic failure energy dissipation characteristics of sandstone. H. Shock Vibrat. 10 pages.

Molla, M.M., Rahman, E., Khatun, A., Islam, M.F., Uddin, M.Z., Ulla, M.A., Saha, M.G., Miaruddin, M. 2017. Color retention and extension of shelf life of litchi fruit in response to storage and packaging technique. Am. J. Food Technol. 12(5):322-331.

Ramli, R.A., Azmi, A., Noorsa, R., Johari, N.S.M. 2017. Minimally processed jackfruit opportunity for the foodservice industry. J. of Food Res. 6(1):1-6.

Ranganna S. 1995. Handbook of analysis of fruit and vegetable products. Edn 2. Tata Mc-Graw-Hill Pub. Com. Ltd., New Delhi, 1112p.

Rojas-Grau, M.A., Oms-Oliu, G., SolivaFortuny, R., Martin-Belloso, O. 2009a. The use of packaging techniques to maintain freshness in fresh-cut fruits and vegetables: A review. Int. J. Food Sci. Tech. 44:875-889.

Salami, P., Ahmadi, H., Keyhani, A., Sarsaifee, M. 2010. Strawberry post-harvest energy losses in Iran. Res. 4:67-73.

Semeerbabu, M.T., Kudachikar, V.B., Revathy, B., Ushadevi, A. 2007. Effect of post-harvest treatments on shelf-life and quality of litchi fruit stored under modified atmosphere at low temperature. J. Food Sci. Technol. 44:107-109.

Lee, S.K., Kader, A.A. 2000. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. Postharvest Biol. Tec. 20: 207–220.