Study on post harvest treatment of guava (*Psidium guajava*)

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**Abstract**

Guava (*Psidium guajava L.*) is a climacteric fruit and it ripens rapidly after harvest and it has short shelf life. Hence the guava fruit can be coated with edible materials to delay the ripening and to extend the storage life. Guava fruit were coated with two different combinations 2% corn starch along with 2% neem oil and 2% rice starch along with 2% neem oil. The fruits were packed using Low Density Polyethylene material (LDPE). The treated fruits were stored under low temperature condition at 6°C and also at ambient condition at 25°C. The results suggested that the coating with 2% corn starch along with 2% neem oil proved most effective in retaining the overall quality as it caused minimum changes in most of the physical and biochemical quality characteristics. In general, all treatments caused significant decrease in physiological loss in weight, fruit firmness, pectin content and total acidity. Fruits stored at ambient condition (25°C) developed faster ripening, pleasant flavor and over softening on further storage. The optimum temperature for storage of guava fruits was 6°C and 90-95%RH for maintaining highly acceptable sensory quality. At this temperature the fruits had attractive colour, pleasant flavor and acceptable quality and can be stored up to 5-6 weeks. Application of 2% neem oil significantly reduced the fruit rot and black spot caused by *Pencillium expansum* and helped to maintain the stability and cellular integrity.

**Keywords:** Guava, Coating, Shelf life, Edible coating, Starch


**Introduction**

Guava is the fourth most widely grown fruit crop in India. Guava is a climacteric fruit and so when it ripens, it bruises easily and is highly perishable (Singh *et al.*, 2007). Fruits for processing may be harvested by mechanical tree-shakers and plastic nets. For fresh marketing and shipping, the fruits must be clipped when full grown but under ripe, and handled with great care. The presence of vitamin C and other phyto-nutrients, such as carotenoids, isoflavonoids and polyphenols, in guava has led to it being an effective antioxidant. Storage life of guavas is prolonged at 20º C (Augustin and Azizah, 1988), relative humidity of 85%, less than 10% carbon dioxide, and complete removal of ethylene. But in the case wax coating treatment, the wax is not edible. It is also available very rare and hence it is expensive.

Guavas kept at room temperature are normally overripe. But if wrapped using polyethylene material, the produce will be in good condition for 9 days. In cold storage, fruits wrapped using polyethylene material remains unchanged for more than 12 days. Wrapping checks weight loss and preserves glossiness. Unwrapped guavas, just turned yellow, have kept for 4 weeks in cold storage at 8.33º-10º C and relative humidity of 85-95%, and were in good condition for 3 days thereafter at room temperature of 76º to 87ºC (Singh, 2007). Guava was susceptible to dehydration during storage and weight losses of 20%, 14%, were recorded after 8 days of storage at 26ºC, 20ºC respectively. The weight loss from the fruit is
dependent on both the temperature and duration of storage. The rate of water loss from the fruit was higher at higher temperatures (Hawlader et al., 2004).

Reyes et al., (1995) has reported that storage of guava (Psidium guajava) at 15°C delayed deterioration of quarter yellow and half yellow fruit and allowed gradual ripening of mature-green fruit in 11 days. The ripening was delayed most by the lowest temperature (10°C) for the mature-green fruit, and decreasingly less for the ripened fruit and higher temperatures (20°C). Titratable acidity (TA) and total soluble solids (TSS) of fruit at mature-green stage were not significantly affected by ethylene treatment. Mahajan et al., (2009) has optimized the storage temperature for guava fruit and also their storage behavior has been studied at optimum temperature. The storage of guava at low temperature for a definite period will increase the shelf life of the produce. The fruits stored at 5°C did not ripen and developed skin bronzing after two weeks in storage. Two hundred and sixteen fruit of different stages of ripeness (mature-green, quarter-yellow and half-yellow) were stored in 10, 12.5, 15 and 20°C. Storage of fruit below 10°C cause severe chilling injury symptoms in the form of surface pitting, skin and flesh browning. Singh and Pal (2009) investigated the potential of ionizing radiation for improving physiological response, quality and storage time of fresh guava fruit. Irradiation treatment also retarded the physical and biochemical changes associated with ripening changes can be decreased by exposure of doses to 0.25kGy at 10°C. Ionizing radiation treatment helps to improve post harvest life and maintain quality of fresh guava fruit.

Coating with edible materials is one of the preservation techniques can be used for fruits and vegetables. Coating of apple can be done by using the combination of Corn starch and Neem oil, Rice starch and Neem oil, since carnauba wax is expensive. Guava can also be coated with the above combination since guava fruit helps in high retention of acidity. Edible coating can be done in order to reduce the cost of the process and also to delay the ripening changes in guava fruit (Wijewardane and Guleria, 2009). Hence keeping all these views and facts in mind, the present study was envisaged with the following objectives: to coat the guava with the combinations of 2%Neem oil along with 2% corn starch and 2%Neem oil along with 2% rice starch, to package the fruits with LDPE (Low Density Polyethylene) material and store under two different conditions and to study the storage life of coated guava at regular intervals.

Materials and Methods

The guava variety used for coating is Psidium guajava simply referred to as Apple Guava were selected for the present study. The fruits were bought from local market as a bulk in Erode (TamilNadu) and has been selected at the colour break stage. The fruit which gets bruised or damaged has been removed. Then they were washed with tap water for the removal of dust, sand, stalks and foreign matters and also dried for the removal of moisture. The fruits have been weighed and considered it as initial weight.

The raw materials used for coating of guava are Corn starch, Rice starch and neem oil to delay the ripening process and to reduce the respiration rate of guava. Initially guava is coated with carnauba wax. Since this wax coating is costly and rarely available it is alternated with starch coating. The Main advantages of starch coating are very cheap, commercially available and do not affect the quality of the produce. Corn starch is the starch of the corn grain. In a cup, half the amount of water and two table spoon of corn flour were mixed and formed as slurry. Then the slurry has been heated by raising the temperature. Then they were continuously stirred to form a thin substance. At 64°C the slurry got gelatinized and starch has been obtained. The temperature of the starch has been found using
thermometer. The starch slurries were started to swell and formed as a gel. The rice grains which has been bought from local market. The powdered flour has been used for preparation of rice starch. The method of preparation of rice starch was similar to corn starch preparation. The starch concentration has been bought to 2% by mixing 2 gm of starch in 100 ml of water. Then they were mixed by continuously stirring since the starch has good digestibility.

Neem oil has been found easily and commercially. The neem oil for the present study of coating was bought from local market. The neem oil concentration was brought to 2% by mixing 2ml of oil in 100 ml of water. It was stirred continuously since oil is not soluble in water. It has been tried by adding two or three drops of surfactants such as detergent solution to solublise the oil with water uniformly. The packaging material used for packing the coated and uncoated guava fruit were Low Density Polyethylene material (LDPE). It has been considered as one of the polyethylene materials protects from harmful ultra violet rays and is water resistant. Fruits are cleaned thoroughly with distilled water and dried at ambient conditions. Fruits were coated with rice starch and corn starch along with neem oil in a different combination by pouring method. The coated guava fruits were packed using LDPE materials. Then fruits were stored at two different storage conditions. The physio-chemical properties of coated guava such as physiological loss in weight, total soluble solids, total sugars, titratable acidity, ascorbic acid and pH were monitored to study the storage life.

Table 1: Design of experiments for coating of guava

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Storage Conditions: S1-Atmospheric Condition (25°C -27 ˚C) and S2- Refrigerated Condition (6˚C)

Coatings: C1-Neem oil (2%) + rice starch (2%), C2-Neem oil (2%) + corn starch (2%), C3 -control sample (without coating)

Results and Discussion

The physicochemical properties includes physiological loss in weight, total sugars, total soluble solids, total acidity, ascorbic acid content and pH were analyzed for coated fruits that were stored under two different storage conditions at regular intervals.

Physiological loss in Weigh

During storage, an increase in physiological loss was observed in both the combinations of rice starch and corn starch coating treatments up to 42 days of storage period. In corn starch, the physiological loss in weight was around 2.01% at 6°C and in ambient condition, it was around 2.04 % as shown in Fig. 1 & 2. In rice starch coating, the physiological loss was around 2.28% at 6°C and less when compared to ambient condition (25°C) around 2.35%. The guava fruit without coating has high PLW increased from 0% to 2.54% at ambient condition than at refrigerated condition.

Total Soluble Solids

In the corn starch coating under refrigerated storage, the total soluble solids has been increased to peak value of 9.8 % at the storage period up to 21days and declined during remaining period. In the treatment of rice starch the soluble solids has been increased to maximum level of 10.5% at the storage period up to 21 days and reduced further to 5.8 during 28 days (Fig. 2). Increase in total soluble solid is due to the hydrolysis of insoluble polysaccharides into simple sugars and is one of
the primary substrate for respiration (Hind et al., 2003).

**Total Sugars**

The total sugars, like soluble solids were fairly low at harvest stage and increased during storage and reached maximum value and followed by further decline. In this study, the fresh fruits (without coated) has the total sugars maximum up to 10% during first 14 days at 6°C and at ambient condition 25°C, the total sugars was around 11.9% for first 7 days and were decayed after 7 days of storage period.

![Graph of Changes in Physiological Loss for Treated Guava Upon Storage](image)

**Fig. 1: Changes in physiological loss for treated guava upon storage**
The fruits coated with corn starch at 6°C has increased to 6.2% and reduced to 3.7% during 42 days of storage period. At ambient condition, the total sugars was increased to 7.4% and declined to 3.9% during 28 days of storage period. The fruits coated with rice starch at 6°C have showed the increasing trend in total sugars up to 9.3% and after it was reduced to 3.7% during 21 days of storage period. At ambient condition 25°C, the total sugars was increased to 8.5% and declined to 4.2% up to 21 days as represented in Fig. 3.

Fig. 2: Changes in total soluble solids for treated guava upon storage

Total Acidity

The maximum total acidity of about 50% was recorded in response to coating with corn starch under refrigerated storage (6°C) whereas at ambient condition (25°C) the maximum total acidity has increased from 29.6% to 44.8% at 28 days of storage period. An increasing trend from 25% to 41% in total acidity for the coating treatment with rice starch was observed at 6°C but in the case of ambient condition total acidity was found to increase from 34.3% to 54.3% at 21 days of storage period. Singh and Mohammed (1997) have reported that rice starch coating helps in high retention of acidity. In ambient condition the total acidity was around 78% at 7 days after which the fruits were decayed are represented in Fig. 4.

Fig. 3. Changes in total sugars for treated guava upon storage

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Ascorbic Acid Content

The guava fruits stored under refrigerated storage conditions have more amount of ascorbic acid than it is in ambient condition. Under refrigerated (6°C) storage and corn starch coating treatment has the maximum value of 180.5 (mg/g) which is reduced to 123.5 (mg/g) at 42 days of storage period. In the treatment rice starch, the ascorbic acid content has the maximum value of 185.9% and reduced to 115.9% during 28 days of storage as shown in Fig. 5. Lin et al., (1988) has reported that the fall in ascorbic acid during storage might be due to its oxidation. Ascorbic acid content of fresh weight was maximum at harvest, which has reduced level at the end of the storage period in guava fruit (without coating). After the reduction of AA, the fruits have been found to be decayed and were disposed.

![Refrigeration at 6°C](image1)

![Ambient condition at 25°C](image2)

**Fig. 4:** Changes in total acidity for treated guava upon storage
**pH (Hydrogen ion concentration):**

The decrease in pH was found to be up to 3.7 in corn starch coating treatment under refrigeration storage but in rice starch coating treatment decreased up to 3.9 (Fig. 6). There was a gradual decrease in the level of pH in both treatments respectively. Wijewardane *et al.*, (2009) have reported that there was a gradual increase in pH due to decrease in organic acid content.

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**Fig. 5: Changes in ascorbic acid for treated guava upon storage**
Comparative analysis

It was observed that the fruits stored at refrigerated condition (6°C) has less increase in physiological loss in weight, total soluble solids, total sugars, titratable acidity and has reduced value in ascorbic acid, and pH than fruits stored under ambient condition at 25°C. Normally, guava fruit (without coated) has reduced storage period than the fruits coated with corn starch and rice starch.

Corn starch coating of guava had the shelf life of 42 days when fruits stored at 6°C and at ambient condition 25°C, the shelf life has been lowered to 21 days. Rice starch coated l has the storage life of 35days at 6°C and at ambient condition 25°C, the shelf life has been lowered to
28 days. The fresh fruits (without coated) has the storage life of 21 days at 6°C whereas at ambient condition, it has been reduced to 7 days of storage. The fruits stored under refrigerated condition have more shelf life when compared to the fruits stored under ambient condition.

**Conclusion**

This study has been concluded that the best storage condition was refrigeration at 6°C since the control sample remained fresh at this temperature till 21 days whereas in rice coating treatment, fruits decayed after 28 days and in corn starch the fruits remained fresh till 42 days of storage period. It has also been concluded that the guava coated with corn starch and neem oil has increased storage period of 42 days than rice starch and neem oil coated fruits which has the storage life of 28 days at 6°C.

**Reference**