Physical and Mechanical Properties of Local Fruits

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Introduction

One of the major problems faced by the local fruit industry is the lack of proper understanding and technology in post harvest practices. The lack of proper post harvest practices has resulted in physical injuries to the fruits, which in turn causes loses in revenue to the fruit industry. Mechanical harvesting, bulk handling, transporting and storage of fruit and vegetables products need a basic knowledge of their physical and mechanical properties. Mohsenin et al. (1970), defined mechanical properties as those having to do with the behavior of the material under applied forces. From the force – deformation curve, mechanical properties like rupture force and energy of the tested specimen can be obtained. According to Abu Bakar Hamid et al. (1992), different countries have different standard specification on grading the fruits. The specifications are based on maturity, shape, size, color, degree of blemishes and taste. Therefore, the physical properties of the fruits are important in the grading operation. Subjecting fruits to cool storage can extend storage life of fruit. Most local fruits show an optimum storage temperature between 10°C to 15°C. Papaya can be stored for 3-4 weeks at the storage temperature 10°C to 15°C and relative humidity 85 – 90%. Whereas guava can be stored for 4 - 5 weeks at the storage temperature 5°C to 10°C and relative humidity 85 – 90%. (Abdullah Hassan et. al 1988). The physical and mechanical properties of some local fruits were studied. Also the effects of cooling delay on chilling injury, quality and storage life of papaya were studied.

Materials and Methods

Freshly harvested fruits (papaya, guava, mango, and ciku) were used in the study. At the laboratory the fruits were cleaned, weighed and tagged for identification. Their physical properties were evaluated. Then these samples were tested for their mechanical properties using the Instron machine. The rest of the fruits were stored at ambient condition and in a cool storage room at 10°C to 15°C with relative humidity of 90 – 95%. Experimentation on the physical and mechanical properties of the fruits was carried out weekly for the following 5 weeks. The physical properties evaluated were weight, volume, density, surface area, moisture content, color, and ripeness appearance. The volume of each was determined by water displacement method. Surface area was determined by tracing the peelings of the fruits on a graph paper. Moisture content was determined using oven method at 103°C for 24 hours. Color, ripeness and freshness appearance were determined visually. Among the mechanical properties evaluated were the rupture force, rupture deformation, rupture energy and modulus of elasticity. From the force – deformation curve obtained from Instron machine, the mechanical properties were determined. For cooling delay study, papayas of maturity index 2 were stored at 26°C ± 2°C (control) and in the cool room (13°C ± 2°C) approximately 24, 48, 72, and 96 hours after harvest. Storage and fruit's temperature were monitored using data acquisition system to obtain cooling rates. Physico-chemical properties namely weight loss, moisture content, firmness, rupture force, citric acid content total soluble solids (TSS) and pH were recorded. Fruits were also access for chilling injury symptoms.

Results and Discussion

Average weight of papaya ranged from 0.72 kg – 0.83 kg. The average weekly weight of guava was 0.31kg – 0.35 kg. The average density for papaya ranged from 783.74 kg/m^3 to 891 kg/m^3, where as the average density for guava ranged from 645.3 kg/m^3 to 831.2 kg/m^3. The moisture content for papaya at harvest was 86.17% and 85.83% for guava. Guava lost moisture faster during storage than papaya. Papaya started to shrivel at moisture loss of 3.63% i.e week 3. Where as guava started to shrivel at moisture loss of 6.29% (weeks 3). After 4 weeks in storage, guava was unacceptable for market due to deterioration of the fruit. Papaya did not deteriorate as rapidly as guava. Papaya was unacceptable for market after 5 weeks in storage i.e. at moisture loss 9.98%. It was found that the stem end displayed more resilience to mechanical damage than the middle end and front end. The force, modulus of elasticity and energy to rapture decreased with the increased time in storage in both types of fruits. Mangoes need 4 to 5 storage days to ripe at ambient condition. Weight loss increases with increase of storage period. Moisture content of mangoes varies from 75% to 84%. Rupture load decrease with increase of storage period for both horizontal and vertical orientation of mangoes. Rupture load at horizontal orientation is higher than at vertical orientation. Rupture deformation decrease with increase of storage period for both orientations. Rupture deformation is higher at vertical orientation than at horizontal orientation. The unripe mangoes were firmer than ripe fruit. This means that firmness of the fruit will decrease with increase of storage period. The fruit at horizontal orientation is firmer than vertical orientation. Firmness of fruit can be use to determine ripeness of fruit. Longer cooling delay of papaya resulted in higher half-cooling time, higher weight loss, better colour development, higher TSS and lower in firmness and lower in chilling injury occurrences when compared to the shorter cooling delay. No good correlations were found for moisture content, rupture strength, pH,

TA and citric acid content in relation to cooling delay. All treatments had acceptable quality up to the second week of storage for the cool room treatments, while the control had acceptable quality up to nine days. The results show that Eksotika papaya can tolerate up to ninety-six hours of cooling delay for a storage life of up to two weeks.

Conclusions

From the results of this study, one can conclude that the best way to pack papaya and guava would be to face the stem end toward areas most susceptible to compression load during transportation. This is due to the relatively high strength of the stem end in comparison to the middle and front end of the papaya and guava. For mango, we may conclude that fruit at horizontal orientation can withstand higher load compare to vertical orientation. Thus, mangoes at horizontal orientation are recommended packaging, storage and postharvest operation requirement. Firmness, rupture load or rupture energy can be use to determine or evaluate the stage of ripeness of mangoes. For ciku fruit, its firmness and density can be used as an indicator of ripeness. For papaya, cooling delay of 96 hours is acceptable for cool storage up to 2 weeks.

Benefits from the study

The study has produced a few benefits. Data on properties of fruits studied can be used in the design and operation of machines, packaging method and techniques for processing of local fruits. Effective strategies in cooling and storage of papaya were developed.

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None.

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