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Effect of pre-transport cold water treatment on postharvest quality of pawpaw fruits.

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ABSTRACT

The study determined how the quality of marketable fruits of papaya (Carica. papaya) could be affected by pre-harvest water cooling treatment. Two different fruit shapes (oblong and oval) were harvested on the same day, in November 2010. Fruits were harvested from Edo State of Nigeria and transported by road to Minna, Niger State. The effect of pre-transport cooling on moisture loss; days to ripening and colour change; fruit aroma, fruit rot and firmness/ peelability of the pawpaw fruits were tested. Results showed that untreated fruits lost significantly more moisture than treated fruits. Shrinkage of the fruits began first in untreated fruits, then 2hrs. and finally 5hrs, cold water treated fruits. Oval shaped fruits were better than oblong fruits when fruit firmness/peelability was considered. Since postharvest cooling removes field heat in fruits, proper cooling should suppress enzymatic degradation, lower water loss in fruits thereby prolonging good fruit quality before arrival to consumers' tables.

Key wards: Carica papaya, consuming public, Fruit rot, firmness/peelability

INTRODUCTION:

Pawpaw (Carica papaya) is an evergreen, tropical American tree crop, but is also cultivated in semitropical zones around the world specifically for its fruits. Generally the fruits size could range from 1kg to 5kg per fruit. Its importance in the world fruit trade is next in rating to banana with citrus having the largest fruit trade demand (Samson, 1980).

The coloured flesh of the fruits is juicy and silky smooth, with an exotic sweet-tart flavour. The large center cavity is packed with shiny, grayish – black seeds. The fruits are eaten fresh when ripe but while slightly green, could be cooked as a vegetable. In Hawaii, 93% of the pawpaw grown feeds the local fresh market (Anon, 2006).

The fruit contains papain, a digestive enzyme that is used as meat tenderizer. Pawpaw is also a very good source of vitamins A and C. The improvement of product quality and reduction of post-harvest losses is our main concern. It is also that of producers; middlemen; marketing specialist and consumers. Today, enormous volumes of quality fruits and vegetables are available to millions of people living in technologically advanced countries through improved postharvest handling methods. In most developing countries however, these are lost for lack of facilities and proper technological know-how on handling and processing.

Mature fruits transported from areas of production to markets may be bedeviled by delays due to bad roads; vehicles or mishandling along the transportation value chain (Idah, et al, 2009). Improper handling procedures of fruits and vegetables in developing countries along with poor storage, packaging, transport and handling technologies are practically non-existent. Hence, considerable amount of produce are lost (Jobling, 2000). More fresh fruits will therefore be needed in less developed countries to supply the much desired nutrients as is provided by fruits and vegetables. Transportation of more produce from areas of greater production to places of none or low production will

therefore be necessary. There is need to also store more commodities longer than will otherwise be required for an all-year-round supply.

Thompson (1971) reported that much more time is being devoted to the production and culturing of plants than is to determining how to prolong the shelf life of the fruits. So much money is spent on irrigation, fertilization and crop protection measures only to be wasted soon after harvest. It is important that postharvest procedures be given as much attention as production practices from planting stages until the product approaches the consuming public. There must be a mutual undertaking between the growers and those who handle the products after harvest (Anon, 1979; Dunn et al., 2009).

The main objective of this study was to determine if the pre-harvest cold water treatment of pawpaw before transportation will have any significant effect on the postharvest quality, and to establish the appropriate means of transportation or packaging of pawpaw fruits that will add value to the quality of the produce before getting to the consuming public principally in developing economies.

MATERIALS AND METHODS.

The pawpaw fruits used in this study are popularly grown in Edo State, in the South-South region of Nigeria (Plate 1). They were transported to Minna, in the middle belt of the country and to elsewhere where they are consumed as fresh fruits or used for industrial purposes.

Plate 1. A sample of the pawpaw tree from where samples were taken.

Fruit harvesting and processing for transportation.

The pawpaw fruits were harvested with a long picking pole. This was used to snap/pluck the fruits from the tree following the method described by Kader (1983). Care was taken that the fruits did not fall to the bear floor or hard surfaces to induce internal bruising or crushing. Two local varieties (differentiated on the basis of fruit shape) were harvested viz; oblong and oval fruit types (see Plates 2 and 3). Cleaning of fruits was carried out to remove dried leaf debris or dirt that may have been attached to the fruits due to presence of latex on the fruits. Both debris and the latex were cleaned before the treatment began.

Plate 2. A sample of oval pawpaw fruits used in the study.

Plate 3. A sample of oblong pawpaw fruits used in the study.

The fruits were harvested at 5.00 pm in the evening when marketable pawpaw fruits are usually harvested in this area. The oval shaped fruits were as long as they were broad while the oblong shaped were about 1.5 times longer than they were broad.

Pre-transport fruit-cooling treatment.

Immediately after harvesting, five fruits each from the two fruit shapes were selected for cooling. They were placed in cold water (Robert, et. al., 1986; Marler, 1994 and Anon., 2006) for 2 and 5 hours respectively before transportation. Another set of five were not put in cold water serving as the control treatment. In order to eliminate any bias due to plant types all pawpaw fruits were harvested from three pawpaw trees that had enough fruits to cover the treatments of the study.

Transportation.

The properly labeled fruits were transported from Edo State to Abuja and then to Minna. The takeoff time was 5.30am for the journey that lasted 9hrs 45min. A pickup van was used in transporting the fruits. Although the pawpaw fruits were conveyed along with items like drums of palm oil, care was taken that no compressive force was exerted on the fruits, guarding against bruises or spot damages (Ryall and Pentzer, 1982). The vehicle was well ventilated. All the fruits were inspected on arrival to the Laboratory, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Nigeria such that infected ones could be removed. No fruits had bruised, ripened, or rotted.

Fruit storage treatment.

In the laboratory, the fruits were packed and well arranged in different baskets according to the treatments (number of hours cooled in water). The method described by Paull *et. al.* (1997) was used, where the pawpaw fruits were kept at room temperature about $23^{o}C - 27^{o}C$.

The fruits were stored till they started showing signs of ripening and then to rotting (Paull *et. al.,* 1997). Weight loss was evaluated during the storage period. The fruits were weighed every three days starting from day one of storage. The percentage weight loss over the storage period was computed based on the initial fruit weight and equation:.

$$\text{Moisture content}\ (\%) = \frac{\text{Weight loss}}{\text{Weight of sample taken}} \text{ x } 100.$$

Visual examination of the fruits was undertaken to assess for rot development before taking the fruit weight. Other parameters were monitored were: level of ripeness and colour change of fruits; change in fruit aroma; fruit firmness; degree of fruit rot and peelability of the fruits as affected by the different levels of cooling.

A Likert quality indexing score (Sidhu and Webster, 1977) of 1-5 (where 1 was Rotten; 2 -Bad; 3 - Fair; 4 - Good and 5- Excellent) was used to determine the quality of fruits

Data Analysis

The data obtained was subjected to statistical analysis using Minitab release 14 (Statistical Software Inc.). Difference in the parameters as a response to the cold water treatments and the shape of the fruits was determined using analysis of variance (ANOVA) test and frequency distribution while diagrams were used to elaborate on salient but important points.

RESULTS AND DISCUSSION

Effect of pre-transportation cooling on moisture loss of pawpaw fruits.

Moisture loss of the fruits was dependent more on the cooling regimes than on the fruit shapes or the interaction between the shape and period of cooling. Fig. 1, shows that the control fruits lost significantly more moisture than the

treated fruits. Fruits placed in water for 2 hours lost significantly more moisture (27.6%) compared to (27.6%) for those placed in water for 5 hours (that lost about 16% moisture).

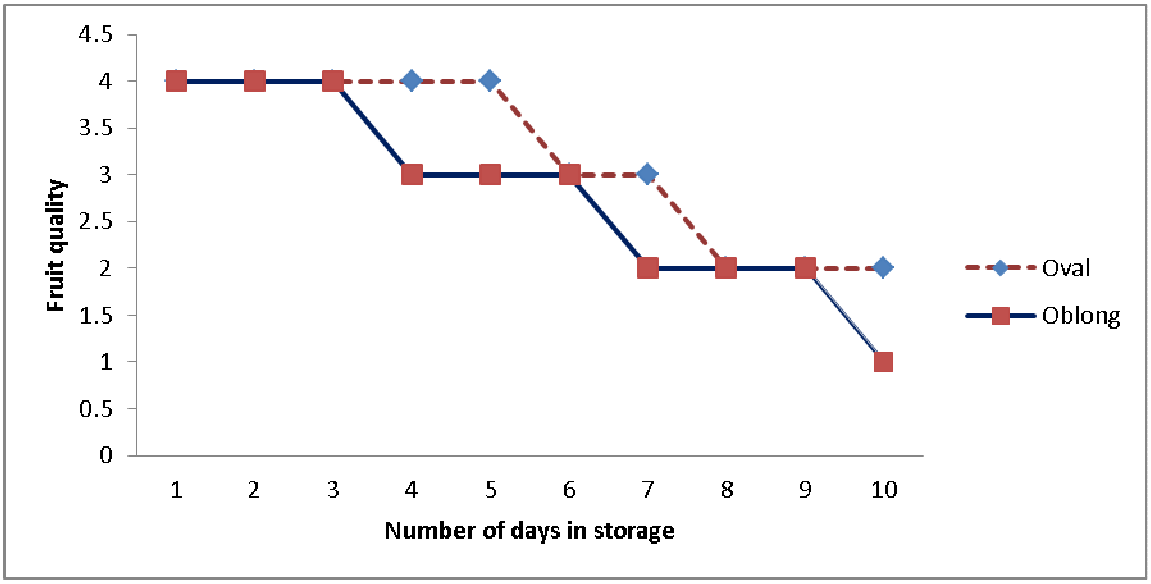

Fig. 1. Pawpaw fruits treated in cold water for 5 hours before transportation.

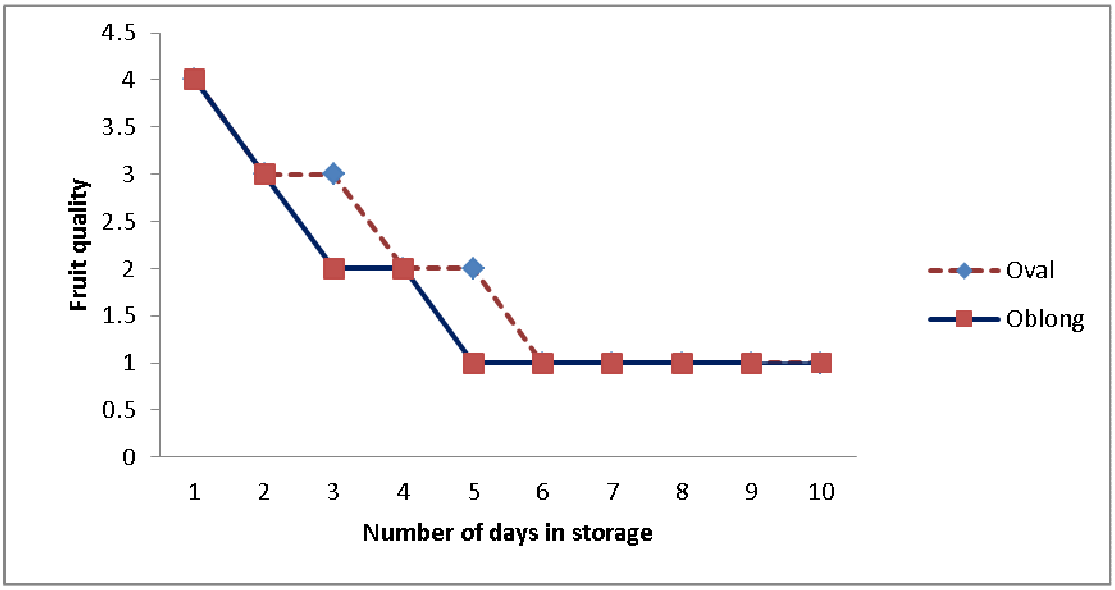

Fig. 2. Pawpaw fruits treated in cold water for 2 hours before transportation.

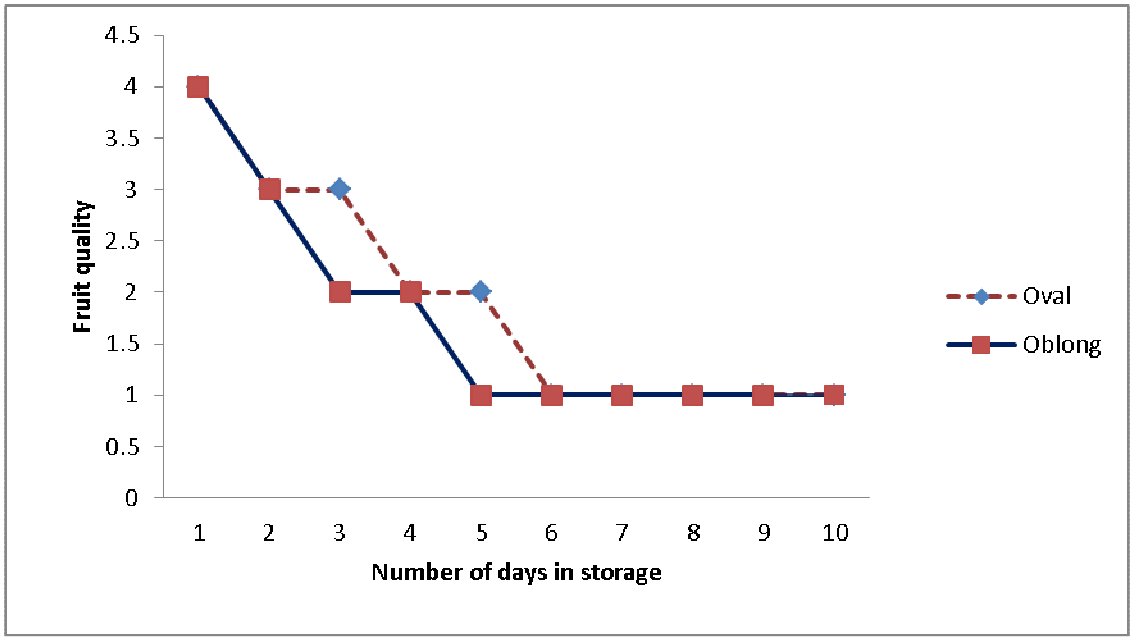

Fig. 3. Pawpaw fruits for the control (not treated in cold water) before transportation

Effect of pre-transportation cooling on ripening and colour change of pawpaw fruits.

Oblong pawpaw varieties not cooled started showing symptoms of ripening and colour change (green to yellow) much earlier than water cooled fruits. Ripening and colour change started from day 2 for oblong fruits, while the delay of up to 1 additional day was observed for the oval shaped fruits.

Significant difference in ripening and change in color was observed between fruits cooled for 2 hours and for 5 hours from about the 3rd day between the shapes of the fruits. About 85% of the fruits treated in cold water for 5 hours still maintained good quality when compared to the group that were not cooled after 5 days.

Effect of pre-transportation cooling on firmness of Fruit Skin.

A result of the analysis of variance for firmness of fruit skin showed that when the pawpaw was cooled for 5 hrs. before transporting, it had a mean score value of 2.8. This was closely followed by mean score value of 2.4 for fruits cooled for 2 hrs. Fruits from the control treatment had the poorest mean score of 1.7

Although the mean score value were not too different between fruit shapes, but it was clear that the oval shaped pawpaw fruits appeared to have better firmness compared to the oblong shaped fruits.

Effect of pre-transportation cooling on the aroma of pawpaw fruits.

Fruit aroma was better among fruits cooled for 5 hrs. and had a mean score of 3.4. This was followed closely by fruits cooled for 2 hrs. with a mean of 2.6 The untreated fruits had an awful aroma scoring 2.1 meaning that the aroma was bad

By the third day, all the fruits treated for 5 hrs. had a mean score value of 4.1. This however, started to change by the fifth day as the fruits had started losing the sweet fruit aroma, giving way to a strong astringent odour from all the fruits that were not treated. The sweet fruit aroma had deteriorated to that of an offensive smell of rotten pawpaw by the seventh day of treatment except for those fruits cooled for 5 hrs that retained the sweet aroma for up to seven days

Effect of pre-transport cooling on the rot in pawpaw fruits.

The result of the effect of cooling on rot development in pawpaw fruits was not different from that of fruit firmness. The result of the ANOVA for the rot of pawpaw fruits revealed that fruit rot was lower when the fruits were cooled for 5 hrs, compared to when they were cooled for 2 hrs., while fruits in the control treatment showed the highest fruit rot.

Effect of pre-transport cooling on the peelability of pawpaw fruits.

The result on the effect of cooling on peelability showed that this variable was intensely affected by the cooling treatment where fruits that had been cooled for 5 hrs. were easily peeleable compared to 2 hrs cooled fruits or even that of the uncooled - control treated - fruits that had lost its firmness (becoming more leathery). Effective peeling of samples could not be done successful after the third day for the control treatment and beyond the 6th day for 5 hrs cooled samples.

DISCUSSIONS

One of the problems in post-harvest handling of pawpaw is lack of storage facilities. Akinrele and Edwards (1973), estimated that because proper storage and processing facilities are rarely non-existent in developing countries, up to 10% of the fruits produced in Nigeria can be lost on the farm, a further 12 – 20% could be lost at wholesale levels while another 20 – 30% are lost at the retail levels. The share quantity of fruit wastage must have impelled Kasimila, et. al.; (2001) to conclude that the lack of storage facilities (for fruits and vegetables) should be blamed, when considering the future of these produce in developing countries like Nigeria. These researchers alleged that despite so much money spent on irrigation, fertilizers and crop protection measures, much of the crops produced become wasted within a short time due to the very poor storage facilities.

Another area that is causing lots of setback to fruits like pawpaw in postharvest handling is that of transportation. Many of fruit bruising occur during field to market transportation. In the course of this study, abrasion and vibration bruises were associated the fruits that had been badly handled - (no fruits of this category were found in this study). This may not be unconnected with the bad roads the fruits had been moved over and the fruit - fruit vibration contact.

This may explain why Ryall and Pentzer (1982) stated that the use of “plastic liners” for bin sides and tops and the additions of air suspension on trucks could help reduce vibration injuries to fruits and vegetables by about 6%. All bruises result from rough or improper handling, poorly designed packaging equipment, inadequate supervision during handling of fruits or rough to severe transportation conditions. Avoiding these problems involves an understanding of their causes and a careful study of harvesting, cooling, packaging, transportation and the entire postharvest handling chain. This will contribute to the avoidance of future postharvest losses of fruits and vegetables.

The ability to deliver a quality product to the market and onwards to the consumer could attract the buyer’s attention and give growers a competitive edge. Proper postharvest cooling and handling can help ensure that quality is maintained until the consumer can take possession of the product.

Postharvest cooling rapidly removes field heat from freshly harvested commodities before transportation, storage, or processing and is essential for many perishable crops. Proper postharvest cooling can help among other strategies to:

- Suppress enzymatic degradation and respiratory activity (softening),
- Slow or inhibit water loss (wilting),
- Slow or inhibit the growth of decay-producing microorganisms (molds and bacteria) and
- Reduce production of ethylene or minimize the product's reaction to ethylene (a ripening agent).

In addition to protecting quality, postharvest cooling can provide marketing flexibility by making it possible to market at the optimum time. Being able to cool and store produce eliminates the need to market immediately after harvest, which can be an advantage for high-volume growers as well as consumers who would like to pick their choice at restaurants and grocery stores or even at open markets (Dunn. et. al., 2009).

CONCLUSION

The reduction of postharvest losses before transportation, while on transit and after transportation will substantively improve availability of this category of food for consumption and other uses. Quality fruits can also be available over longer periods of time than is currently the case in many developing countries. We have also shown that fruits cooled in water before transportation, can store longer and therefore bruising and rot can be better minimized.

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REFRENCES

Anonymous, (1979). Post-harvest food conservation. Report on the INSA-NAS Joint Workshop, New Delhi. India.

Anonymous, (2006). Papaya – *Carica papaya*. http:www.uga.edu/fruit/papaya.html

Dunn, J., Harper. J. and Lynn Kime, (2009). Fruit and Vegetable Marketing for Small-scale and Part-time Growers. Penn State's College of Agricultural Sciences on the Web. http://agalternatives.aers.psu.edu/Publications/MarketingFruitAndVeggie.pdf

Idah, P A.; Yisa M G., Ajisegiri E S A.,and Okpala O. (2009). Resonance frequency of Nigerian tomato fruit as related to prevention of damage during transportation. J Fd Sci Technol, 46(2), 153-5.

Jobling, J. (2000). Correct Cool Chain Management is Essential for all Fruit and Vegetables.www.postharvest.com.au/info_Sheets.htm.

Kader, A. A. 1983. Influence of Harvesting Methods on Quality of Tree Fruits Hort-Science 18 (4) 409 411.

Kasimila, B.J. R.M. Wambura and S.A.M. Nnko. (2001). The effects of unavailability of technical storage facilities to the marketing of fruits and vegetables for economic development in Morogoro rural and urban districts *S. Afr. J. Agric. Ext./S. Afr. Tydskr. Landbouvoorl. Vol 30*.

Marler, T. E. (1994). Pawpaw. In: Schaffer, B. and Anndersen, P. C. (eds) Handbook of Environmental Physiology of Fruits Crops Vol. 2 Subtropical and Tropical Crops. CRC Press Bola Ratan. Florida. Page 216 – 224.

Paull, R. E. Nishijima, W. Reyes, M. and Cavaletto, C.G (1997). A Review of Post-Harvest Handling and Losses During Marketing of Pawpaw (Carica Pawpaw. L.) Post Harvest Biol. Technol. 11. 165 – 179.

Robert, L. Sheufelt, Stanley, E Prussia, and Woodroof (1986). Harvesting, Handling and Holding Fruits. In "Commercial Fruits Processing. (J. G. Woodroof and B. S. Luh eds) page 25 – 97.

Sidhu, G, and Webster J. M. (1977). Predisposition of tomato to the wilt fungus (*Fusarium oxysporum*) f.sp. *lycopersici* by the root-knot nematode (*Meloidogyne incognita*). *Nematologica,* 23: 436–442.

Thompson, A. K. (1971). The storage of mango fruits. Trop. Agr. (Trinidad), 48(1):63-70.

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