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Measures against damage of some perishable products on transit

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Abstract

Postharvest handling of agricultural raw material is a very important aspect of processing and storage engineering that can mar, if not properly handled, or make food product availability in a country. Perishable products are one such raw material that is often damaged on transit. The implications of this damage are the reduction in farmer's income and sometimes complete rejection of produce by consumers thereby leading to total loss in production cost. Therefore in order to arrest this ugly situation measures are presented in this paper against damage of onion, cabbage, carrot, sweet corn, cassava, grape fruit, pineapple, pear, guava, melon, banana, mango, pepper, plantain and papaya on transit. The information provided in this paper is designed to solve the problems encountered during handling, transport and distribution of perishable products in Nigeria.

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Introduction

The major sector of the Nigerian economy is agriculture, providing more than 30 percent of the total annual GDP and employing more than 70 percent of the labour force (Adegboye, 2004). Yearly, farmers produced a lot to boost the economy but most are lost at post harvest stage (Olayemi *el al*., 2011).

Fruits and vegetables are perishable crops produced by farmers and contain 65 to 95 percent water. When food and water reserves of these crops are exhausted death and decay result. Anything that increases the rate at which a product's food and water reserves are used up increases the likelihood of losses. Increases in normal physiological changes can be caused by high temperature, low atmospheric humidity and physical injury (Olayemi *el al*., 2011). Such injury often results from careless handling, causing internal bruising, splitting and skin breaks, thus rapidly increasing water loss.

Losses directly attributed to transport can be high, particularly in Nigeria. Damage occurs as a result of careless handling of packed produce during loading and unloading; vibration (shaking) of the vehicle, especially on bad roads; and poor storage, with packages often squeezed in to the vehicle in order to maximize revenue for the transporters. Overheating leads to decay, and increases the rate of water loss. In transport it can result from using closed vehicles with no ventilation; stacking patterns that block the movement of air; and using vehicles that provide no protection from the sun. Breakdowns of vehicles can be a significant cause of losses in some countries, as perishable produce can be left exposed to the sun for a day or more while repairs are carried out (FAO, 1989).
Not only are losses clearly a waste of food but they also represents a similar waste of human effort, farm inputs, livelihoods, investments and scarce resources such as water (World Resource Institute, 1998). Major technical roles of agricultural sector are the reduction of food losses, as a result of mechanical damage in particular, and the enhancement of food safety and quality.

However, since most of the mechanical damages to perishable products occur in transit, it is therefore necessary to address food losses from this stand point. Thus, this review paper aimed at providing measures against damage of some perishable products on transit in Nigeria.

Damages to some fruits and vegetables

The following notes highlight some of the major problems of the more important commodities in the fruit and vegetable group. They are, however, indicative rather than exhaustive.

Bananas and Plantains

Harvesting is generally a one-man operation which frequently results in bruising and abrasions of fruits causing accelerated ripening and consequent decay. Latex staining is prevalent during dehanding. Bunches or hands are often piles one on top of the other without proper protection and fingers are easily detached and oftentimes wasted during transport. This is particularly true of the very open, loose bunches of certain plantain cultivars. In container transport loosely packed hands suffer considerable damage, especially on rough roads. In transit ripening and decay are usually high, notably over long distances (Harvey, 1978).

Mango

Fruits are usually harvested at the time of the day when maximum latex flow is favoured. Latex stain is allowed to dry on the peel, hence immediately reducing consumer acceptability during retail. The collapsibility of the non-rigid crates often used for transport further aggravates quality lose by compression and bruising. The inaccessibility of production area to roads causes serious delays in transport, in addition to a mixed-cargo typo of transport. Stacking in vehicles often does not provide for adequate ventilation. Loading and unloading operations are rather rough. Cold storage is

not usually practiced. Ripening is mainly aimed at improvement of the appearance for sales purposes and not for maintaining quality (MA, 1965).

Papaya

Picking poles injure the fruit and there is a relatively high percentage of fruit dropping on the ground, causing breakage and bruising of ripe fruits. Peduncles are not usually trimmed hence injuring other fruit within the pack. Rigid containers are not adequately lined, and within a single pack fruits of assorted sizes and maturity stages are often found. In bulk transport fruit e arc piled one on top of the other without any suitable padding materials. High percentage of decay, particularly anthracnose, is the main problem during ripening and in retail (MR, 1965).

Citrus

Improper time of harvesting greatly enhances rind injury or *oleocellosis* (Harvey, 1978). Leaving long stubs on fruit injures other fruits within the pack. Containers used are large and over packed, generally without sufficient ventilation. Containers are piled high with the bottom crates bearing the full weight of crates on top. Delays in transport due to poor roads often cause over-ripening or yellowing of the commodity. Poor storage conditions favour decay and physiological disorders such as chilling injury can also occur if cold stores are not wolf managed (Harvey, 1978).

Grapes

These are attacked by *Botrytis*, *Cladosporium* and *Alternaria* during storage. However, if the storage temperature is strictly maintained between 0° and 2°C, fungal attack can be reduced to a minimum (FAO, 1989). Other loss factors could be berry drop, bruises, injury, water loss, and cracking of berries. Selection of unsuitable container type for packaging of grapes may also lead to heavy transit losses. Transit delays, adverse weather conditions and improper type of carriages, e.g., steel wagons, particularly during hot months may further aggravate transit losses (MR, 1965).

Tomato fruits

These are usually picked when fully ripe, and are therefore very susceptible to cracking, bruising, and consequently decay. Packaging containers often used are deep bamboo crates with insufficient aide reinforcements allowing jarring and compression during transport. Loading and unloading operations are very crude. Handlers tend to throw the pecks rather than lift them gently, on account of their weight. During retail sellers tend to pour the contents of the pack into another container, rather than transferring the fruit gently, thereby increasing bruise damage. Fruit a at the breaker stage are mixed with the fully ripe or three-quarters ripe fruits reducing the market value of the pack. Shriveling percentage can be high since fruits are often exposed to the sun (MA, 1965).

Onions

Insufficient grading is still existent. Spouted, injured and partly decayed bulbs are usually mixed with sound bulbs in a pack. The use of slatted wooden creates is advantageous, especially during transport. Mesh bags of 40-50kg capacity are also used. Sacks are thrown rather than lifted, on account of their weight. Packs are piled one on top of the other with no provision for adequate ventilation. Pre-harvest spraying with sprout inhibitors is seldom practiced resulting in serious sprouting during storage (Harvey, 1978).

Cabbage/Lettuce

Improper harvesting tools contribute greatly to damage to the produce in the form of out a and abrasions. Trimming of outer leaves is usually not practiced. In container transport, large crates are used (50 kg. capacity). Bruising and tearing of the leaves is of common occurrence due to the sharp edges of the containers. Containers are piled one on top of the other with the bottom crates carrying the weight of the heads above. Bulk transport likewise results in higher losses (Harvey, 1978).

Peas and Beans

Factors such as the method of packing, suitability of containers, mode of transport, distance covered, number of transshipments, handling, and storage facilities in the consuming centre, all contribute to the degree of loss reported (MR, 1965).

Pepper

Dried pepper should be transported in areas which exhibit the lowest temperatures during the voyage and are dry. In any event, storage beneath the weather deck or, in the case of shipping in containers, in the uppermost layer on deck, must be avoided as the deck or container is strongly heated by the intense tropical sun and, at temperatures greater than 25°C, essential oils may be lost and there is a risk of self-heating (www.greenpepper.com). At temperatures greater than 40°C, the product dries out by more than 0.5%. If a container is exposed to direct solar radiation, the product may dry out by up to 2% or more. In the hotter parts of the year, the temperature difference between the port of loading and unloading may be 15 - 20°C. In the colder parts of the year, however, it is above 30°C (www.greenpepper.com).

Incoming cold air may cause sudden drops in temperature which, especially in container interiors, may result in a considerable increase in relative humidity. In this situation, low product water content is of vital significance since the higher the water content of the product, the higher the equilibrium moisture content vise versa (www.greenpepper.com).

If the relative humidity of the container air increases its dew point also increases. At relative humidity levels of less than 100%, the dew point is below air temperature (www.greenpepper.com). However, if relative humidity reaches a value of 100%, the dew point is the same as the air temperature and condensation occurs. Corresponding values may be obtained from the psychometric chart. A rapid and major drop in external air temperature can easily reduce the temperature of the container walls/ceiling to below the dew point of the internal air. This results in the formation of condensation on the internal surfaces of the container which drips onto the cargo and may cause damage due to the formation of wetness, mold, self-heating (www.greenpepper.com).

Product protection against damage on transit

Packaging

Packaging is used to protect products and allow them to be received by end users in good quality condition. For most operations involved in the supply of products to remote communities, packaging will not be an issue and packaging provided by packers and manufacturers will be accepted as adequate. However, because of the harsh transport conditions and need to consolidate small quantities of a wide range of products, some additional packaging maybe required to prevent damage and losses. Care needs to be exercised in any repackaging, to ensure that product conditions are maintained, e.g.; ventilation is not restricted, sealed plastic bags or boxes are not used for respiring products (Thompson, 2002).

Packaging factors that need to be considered when transporting product include:

1. Ventilation
2. Product protection (protection against contamination and physical damage)
3. Strength
4. Insulation
5. Labeling

Some of the important characteristics of various types of packaging include (Thompson, 2002):

1. Fibreboard boxes. The strength of fibreboard boxes can be quite variable depending on construction and the type of fibreboard used in their construction. Overall strength and particularly wet strength will be significantly increased when they are wax coated. Generally products packed in fibreboard cartons rely

on the wall strength of the carton to prevent damage to the products inside and hence retaining wall strength is important, particularly when loading, transporting &unloading product.

2. Polystyrene boxes. Adds extra insulation to products that are temperature sensitive, but can be susceptible to cracking.

3. Hessian sacks and net bags. Allows air-flow through the packaging of chilled or dry products. They provide little or no physical protection for the products and should only be top loaded on pallets.

4. Plastic bags or containers. These prevent air-flow to the product during transit (unless perforated), and can be used to maintain a modified atmosphere around the product. Care is required in handling these products, as a break in the bag will destroy the package atmosphere, which can significantly reduce the product's shelf life.

5. Pre-packed Products. Some products may be shipped in small consumer ready pre-packs. These should be packed into fibreboard cartons or plastic crates for convenient handling and to prevent damage during transport and handling.

6. Wooden or plastic bins. Allow for bulk transport of heavy products. They are also useful for the consolidation of small volumes of mixed product lines which are difficult to stack onto pallets in a stable manner. If possible odour producing products should be packaged to prevent odours from escaping.

Palletizing

1. Avoid stacking cartons in a manner that reduces the cartons rigid wall strength.

2. Avoid stacking raw product on top of processed (ready-to-eat) product as this may lead to cross contamination. Also avoid loading ethylene sensitive product on top of ethylene producing products.

3. When palletizing, stack light boxes on top of heavier boxes to prevent package collapse and do not stack products so that air flow is restricted.

4. Avoid placing products that are not in rigid packaging, e.g.; net/hessian/plastic bags, on the bottom of pallets and loading cartons or crates with heavy products on top.

5. Deteriorated product should be isolated from all other product during transit and in storage to prevent contamination (Thompson, 2002).

Pallet wraps

Benefits of pallet wraps:

1. Products can be maintained at a lower temperature over an extended period of time.

2. Reduces cost of cooling products, when returned to refrigerated facilities.

3. Maintains the quality of products by reducing the rate of warming or thawing. Be sure to remove wrap prior to returning the products to cold storage, as this will ensure efficient cooling.

4. Wrapping pallets with plastic film will form barriers between various non-respiring products that can help in reducing the cross contamination by odours (Thompson, 2002).

Types of pallet wraps available:

1. Pallet wraps that restrict airflow over and through the pallet will significantly reduce the rate of warming.

2. Simple non-perforated stretch film that has no effective insulating value can halve the warming rate. Any material that has some insulating value like foil wrap, bubble wrap, cotton or synthetic blankets, will further reduce the rate of warming.

When to use pallet wraps:

1. Once product in the cold room is at the required carrying temperature.

2. Immediately prior to transport and removed as the vehicle is being loaded when temperature controlled loading docks are not available.

3. During transportation. Product that has been pre-cooled could be wrapped to slow warming of

products that may be affected by higher than desirable transport temperatures.

4. At the receival point. If refrigerated facilities are not available at the receival point, or the products are not able to be placed directly into cold storage, pallet wraps will slow down the warming process.

Pallet bracing and separation during transport

Pallets should be braced or strapped to prevent boxes from leaning against the side walls, or rear doors of the vehicle. Air inflated pillows are convenient and very effective.

Types of braces available include:

1. Strapping – Allows spaces for ventilation as well as preventing pallet movement. Suitable for frozen and chilled product. Corner protectors should be used to prevent damage to packaging when using strapping.
2. Netting – Allows product to breathe and air movement through pallets, as well as stabilizing movement of products during transit. Suitable for chilled product that needs to breathe as well as those that does not require high humidity atmospheres.
3. Plastic wraps – Prevents air-flow around products, but firmly restricts movement of load. Suitable for frozen and chilled product that does not expel ethylene gas (Thompson, 2002).

Maintaining temperatures on transit

It is important to note that Products must be cooled to the transport temperature before loading vehicles. (See Table 1 for recommended storage and transit temperatures).

The transport vehicle should be pre-cooled to either

a. Match the ambient air temperature at the time of loading if not using an insulated loading dock or

b. The desired transport temperature if using a loading dock to prevent the products warming from the heat of container walls and floor.

For precooling the refrigeration unit should operate for at least 30 minutes or until the inside temperature of the van is at the set temperature prior to loading.

1. Be sure to close all doors during pre-cooling to prevent ice build up on the evaporator coils.
2. Temperature control will be negatively affected if there is poor air circulation in the refrigerated van or cold room.
3. Broccoli and sweet corn may be packed in contact with (wet) ice to cool or maintain the cooling process.
4. If dry ice is being used for products such as dairy and meat, avoid transporting with live seafood, as exposure to carbon dioxide may be harmful.
5. Any fluctuations in temperatures during handling may lead to degradation in the product's market quality or could be potentially hazardous to food product safety (Ashby, 1999).

Maintaining ethylene levels on transit

Ethylene gas is an important ripening agent used by some commercial enterprises before retail distribution, to improve the quality of some fruit. However, to other perishable crops (indicated in Table 1) ethylene gas can lead to a reduction in product shelf life, affect product appearance or induce physiological disorders. As certain fruits produce significant amounts of ethylene, it is important to ensure ethylene sensitive products are not situated near ethylene producing products or that ethylene is removed during storage/transport using commercial ethylene scrubbers (Ashby, 1999).

Ethylene sensitive vegetables should not be mixed with ethylene producing fruits and dry vegetable should not be mixed with other fruits and vegetables. Products listed at temperatures more than 4^{o}C is sensitive to chilling at lower temperatures. All products are sensitive to chilling.

Ethylene sensitive fruits/vegetables should not be mixed with ethylene producing fruit (Transport and Handling of perishable Products Guidelines, 2011).

Table 1. Recommended storage and transit temperature for some perishable products.

Products	0°-2°C	4°-7°C	7°-10°C	13°-18°C
Dry Vegetables	Onion Galic			
Fruit/Vegetables: *Ethylene Sensitive*	Cabbage Carrot Cut Vegetable Green onion Lettuce Mushroom Spinach Sweet pea	Beans Cucumber Potatoes Tomatillo	Okra Squash Water melon	Tomatoes Mature green
Fruit/Vegetables: *Not Ethylene Sensitive*	Sweet Corn Bean sprouts		Bell pepper	Cassava Sweet potato
Fruit: *Very low ethylene Producing*	Coconut Date Grape Orange Strawberry	Olive Orange Tangerine	Grape fruit Lemon Lime Pineapple	Bread fruit
Fruit: *Ethylene Producing*	Apple Avocado Pear (Ripe)	Guava Honey Dew Melon	Avocado pear (Unripe) Custard apple	Banana Mango Ripe tomato Papaya Plantain

Source: Adopted from Transport and Handling of Perishable Products guidelines, 2011

Conclusion

The importance of perishable products to human diet; and the losses encountered by the farmers as a result of the damage caused in transporting them from the farmhouse to the market, has called for proactive measures to be taken to ensure their wholesomeness. The relevant authorities in Nigeria are encouraged to pickup this challenge through extension programmes, to enlighten illiterate farmers on the most effective ways of handling, transporting and distributing perishable products with little or no damage caused on transit.

References

Ashby, H. 1999**.** Protecting perishable foods during transport by truck. U.S. Department of Agriculture (USDA). Washington DC.

Adegboye, RO., 2004. Land, Agriculture and Food Security in Nigeria. 3rd Faculty Lecture, Faculty of Agriculture, University of Ilorin, Nigeria.

FAO, 1989. Prevention of post-harvest food losses: fruits, vegetables and root crops - a training manual Training Series 17/2, Rome.

Harvey, J.M. 1978. Reduction of losses in fresh fruits and vegetables. Ann Rev. Phytopathology 16: 321-341.

http://www.greenpepper.com

MA. 1965. Marketing of grapes in India. Marketing Series No. 162. Directorate of Min. of Agric. Govt. of India, Nagpur Mktg.

MA. 1965. Marketing of mangoes in India. Marketing Series No. 153. Min. of Agric. Govt. of India. Nagpur.

MA. 1965. Marketing of guava, papaya and litchi. Marketing Series No, 152. Min. of Agric. Govt. of India. Nagpur.

MA. 1965. Marketing of tomatoes in India. Marketing Series No. 152. Min. of Agric. Govt. of India. Nagpur.

MA. 1965. Marketing of garden peas and French lemons in India. Marketing Series No. 154. Min. of Agric. Govt. of India. Nagpur.

Olayemi FF, JA. Adegbola, EI. Bamishaiye and EF. Awagu, 2011. Assessment of Post Harvest Lossses of Some Selected Crops In Eight Local Government Areas of Rivers State, Nigeria. Asian J. Rural Dev., Pp. 1-11.

'Transport and Handling of Perishable Products in Remotes Areas of South Africa Guidelines', 2011. The Government of South Africa in collaboration with South Australian Research and Development Institute and Department for Transport, Energy and Infrastructure.

Thompson, J. F. 2002. Transportation. In: Postharvest technology of horticultural crops, 3rd edn. A. A.Kader (ed.). University of California, California, pp. 259-270.

World Resources Institute, 1998. Disappearing Report on Diseases of Tomatoes in Choba, Rivers State. J. Applied Sci. Environ. Manage., 12: 117-121.