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Packaging and Handling Methods as Sources of Mechanical Damage in Tomatoes in Transit

[1]O. AbdulGaniy Raji and [2]O. Kazeem Oriola
[1]Department of Agricultural and Environmental Engineering, University of Ibadan, Ibadan, Nigeria
[2]Department of Agricultural Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria

Abstract: A study on the causes of mechanical losses in handling and packaging of tomatoes at various post-harvest stages in Oyo state Nigeria was carried out. The major wholesale and retail markets serving as depot for tomato farmers and middlemen were visited. This afforded the opportunity to interact with them and observe their practices through interviews, observation and questionnaires. The study revealed that the major causes of mechanical damages resulting in losses incurred are as a result of the type of packaging materials, method of handling and mode of transportation. The containers used for tomatoes are the woven palm baskets which though strong enough for the handling and packaging of tomatoes when properly handled but are found to fail to protect the produce due to the mode of handling. Bad roads also contribute immensely to damages to the containers while loading methods account for losses by crushing in transit. There are indications that this may not only continue but may increase as a result of lack of assistance and proper extension services, the attitude of the farmers, wholesalers and retailers who stick to their method and lack of interest by the policy makers.

Key words: Packaging and handling method, source of mechanical demage, tomatoes, transit, Nigeria

INTRODUCTION

The problem of food losses, particularly post harvest losses, has been and is still a global problem for a long time especially in the African countries that rely solely on agriculture as the main stay of their economies. In Nigeria, the great potential for food production is widely acknowledged despite the major dependence of the economy on the oil sector. Like other developing countries of the world, Nigeria needs to raise the quantity and quality of food available to its ever growing population, with an estimated annual growth rate of 2.9%. It should be noted however that a major and often neglected step towards achieving a greater level of food increase and security is to prevent looses between the time of harvest up to the consumers' table.

Horticultural produce tends to follow a cyclic path-growth, death, decay and disintegration like other biomaterials. This eventually leads to food losses. It was estimated that defects in post harvest handling, transportation, storage and inadequate post harvest facilities has caused up to 20-40% of fruit and vegetable losses (Jamieson, 1981; Adel, 1998) amounting to billions of Naira annually. In Nigeria, Olorunda and Aworh observed up to 20% losses in fresh tomatoes, pepper and onions. The same level of losses were reported by Bani *et al.* (2006) for tomatoes during handling and transportation in Ghana. The majority of these losses are caused by mechanical damage as a result of static and dynamic stresses during post harvest transit (Aworh and Olorunda, 1981; Olorunda and Tung, 1985). Up to 50% losses were recorded.

Generally, among these three crops the losses tend to be higher in tomatoes due to their high moisture content, soft tissue and high rate of physiological activities such as respiration and transpiration, which made them susceptible to high degree of deterioration and handling damage after harvest. However, there exist a difference in the pattern of losses between developing countries and their developed counterpart with very high percentage of losses recorded in the former most especially in Nigeria. This may not be unconnected with the modernized packaging practices, which characterize the developed economies as against the archaic packaging practices that still characterize Nigerian society where horticultural produce are still being packaged in traditional baskets and jute bags that are handled very roughly.

Corresponding Author: O. Kazeem Oriola, Department of Agricultural Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria

Quantitative assessment of the losses in food crops has not been dealt with extensively in Nigeria. Assessment of food losses is therefore very important so as to quantify the losses, but very little work has been done in the post-harvest food losses assessment in Nigeria. A reliable figure in estimate is necessary for proper assessment of economic worthiness and possible improvement scheme to be introduced having identified the order of magnitude and main causes and the worst affected area. This can only be achieved by extensive studies to obtain a reliable quantitative data from time to time. In addition food crops handling, processing and distribution varies from crop to crop right from farm to the table. This is as a result of the nature of each crop requiring different handling method and different equipment for storage and distribution. Therefore, a generalized method of losses and their prevention cannot be applied. The study is therefore to establish the contributions of poorly engineered packaging materials, as well as inappropriate handling and transportation methods to the level of losses of tomatoes in transit.

MATERIALS AND METHODS

In order to come up with reliable figures on the effect of the methods of packaging and handling in transit on the mechanical and other losses, major markets and off farm distribution centres in Oyo state serving as the depot of the product being brought from the Northern part of the country were visited and interviews as well personal assessments were conducted. These include Shasha market (Ibadan), Eleekara Market (Oyo), Iresaapa market (Ogbomoso), Odo-Oba market (Ogbomoso) and Bodija market (Ibadan). This afforded the opportunity of obtaining information from the wholesalers who buy from the farmers on the farm and transport down south as well as retailers conveying the product from the market to the neighbouring towns and villages hence the harvest, handling and transportation stages are taken care of. The information obtained were cross examined by observing the damaged samples from the products just transported down to the market. Market losses were also obtained by interviewing the retailer at the market as well as observation of the products that has been in the market for some days.

RESULTS AND DISCUSSION

The result of the survey which identified the losses resulting from the method of handling and packaging in transit are discussed below. Tomatoes are generally packed in baskets as against rectangular wooden boxes used in Ghana (Bani *et al*., 2006). The provision of grass

Fig. 1: Tomatoes neatly packed in baskets

Fig. 2: Loading methods

cushion underneath the produce eliminates the problem of bruising and cuts sustained from the rough inner walls of the baskets. Figure 1a-c shows neatly packed varieties of tomatoes in different types of baskets of varying shapes, design and strength (this will be discussed later). Because of the shapes and sizes of some of the basket (somehow deep), the bulk of the weight is carried by the set of tomatoes at the bottom and due to unevenness of the roads, they are broken and at times pressed flat.

In transit from the northern part of the country or from the farm as well as movement from major markets by retailers to other locations, the baskets of tomatoes are stacked on each other with wooden bar separation between stacks. The separators serve as seat/supports for

the upper level to ensure that the product beneath are not crushed (Fig. 2). However, it was observed that often times the tomatoes are not as neatly packed as those shown in Fig. 1 but are packed high in the basket. This results in some of the products extending beyond the upper part of the baskets getting crushed (Fig. 2 a and b). Another method of stacking observed is the alternate baskets placed in between the space created by two to three lower levels.

The upper levels are therefore sitting on the edges of the baskets (Fig. 1c and 2a). These methods though ensure that the products are not touched (where possible) when normally or neatly packed but its efficiency is dependent on the strength of the baskets and the wooden beam separation. Figure 2 a-d shows different types of bars used. This method is, however, used mainly to display the produce especially where space is a major constraint and not for transport purposes (except in carts, Fig. 2a) as transporters want to maximize the use of the limited space. This quest often leads to the common practice of forcing tomato baskets into inadequate space by taking advantage of its non-rigidity, thereby compressing it against its fragile contents and in the process damage them. In Fig. 2b and 2c, the bars/log are not supported at the edges to fully carry the weights of the upper loads but are resting on the baskets, thereby offering no protection for the produce on the lower baskets. With this arrangement, tomatoes situated directly beneath the logs and along these vertical columns are crushed while those adjacent to them are bruised, leading to serious losses. The supporting log/bar in Fig. 2c is also a weak member which has the tendency to break under load resulting in excessive losses. The system in Fig. 2a-c cannot be done in a better way than they are because the carts and commuter buses used are not meant for transporting the produce but improvised due to the economic situation in the country. The truck used in Fig. 2d has provision for supporting the edges of the bar/log(not deliberately) implying that the products will not be seating on each other. Strong wooden logs with grasses and leaves serving as cushion on the product also ensures product safety.

Stacking does not account for significant losses in the large trucks (Fig. 2d) as the basket are separated with enough clearance provided by wooden platforms. This coupled with the 'hausa' variety known for better strength, hardness and toughness that are being brought down from the Northern parts of the country, only 1% losses was recorded in the market as reported by Raji (1992) that the bulk of the losses is due to rough handling. This is evident in the mode of transfer of the product from one basket to the other at the market as shown in Fig. 3. The tomatoes are poured from a height into baskets with rough bodies and in most cases from smaller baskets onto larger ones (not used for long distance movement). This results in bruises and crushing of the lower portion as a result of the heavy load on them (creep). It was also observed that in a way to make the produce more attractive to prospective buyers, the

Fig. 3: Transfer of tomatoes within baskets at the market

Fig. 4: Baskets with different reinforced edges

Fig. 5: Damaged baskets (a and b) as a result of loading on fuel tankers (c)

practice of packing the smaller sized tomatoes at the bottom of the baskets and loading the larger and heavier ones on them deliberately is also contributing immensely to the crushing losses.

The type of baskets used in packing the tomatoes vary in shape, size and design as shown in Fig. 1a-c, 2a-d and 4a. As can be seen the baskets are reinforced on the upper edges and these reinforcements are found to vary, the more the number of rolls the stronger the basket (Fig. 4a and b). Also, the strength of the baskets is determined by the strength and size of the vertical members serving as columns on which the woven threads are wound.

As evident in Fig. 2a-c ropes are used to tie the baskets and keep them in place on carts and commuter buses. This results in excessive pressure exerted on the baskets leading to damages with time on rough roads. The end result of this is crushing and breakages of the baskets as shown in Fig. 5a and b. The baskets shown in Fig. 5 are only usable in the market for transfer or display of product but not for transit. However, as can be seen in Fig. 5a, the baskets was used to transport tomatoes over hundreds of kilometers from the north. It is neatly parked and covered with paper and tied with strings to prevent failure in transit. The tomatoes shown in Fig. 5a (arrowed), has already been bruised by the damaged parts of the basket. This type of damage to the baskets (crushed basket) and eventual damages to tomatoes is common in those packed and loaded onto fuel tankers and commuter buses (improvised vehicles) as shown in Fig. 2a-c and 5c. This effect also calls for question on the reusability of the baskets i.e. the shelf life. The baskets being subjected to all the conditions discussed above are not strong enough to withstand the stresses, hence needs replacement in short time. It was also found out that on some occasions the products are loaded onto the top of commuter buses with little or no support as shown in Fig. 5d.

CONCLUSION AND RECOMMENDATIONS

From the foregoing, it is obvious there are no standard sizes, shapes nor proper designs of the packaging materials (baskets) and no policy on the type of vehicles that must be used for the loading of the fragile product (tomato). This is leading to excessive losses which have been reported in a number of research reports. This problem is general to the developing countries as the developed countries have standardized their methods of handling with the use of strong plastic trays properly designed to take care of crushing losses which account for the majority of losses in the developing countries. There is therefore a need to look into a proper re-design of the basket and enforcement of the type of vehicle and loading method to be used for this product. This will involve a better reinforcement and appropriate selection of the dimensions of the supporting members and the woven threads. This will compliment the efforts that have been made at developing disease-resistant varieties which

has led to a considerable decrease in physiological and microbial damages experienced in transit i.e. an engineering solution is urgently required for the engineering problems, having almost eliminated the biological problems.

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