Biological Reports

Handling Practices of Fresh Tomatoes in Benue State and How they Contribute to Post Harvest Losses

REVIEW ARTICLE

How to cite this article
Atsor,C.T. and Manguts, Y.S.(2019), Handling Practices of Fresh Tomatoes in Benue State and How they Contribute to Post Harvest Losses , ***Biological Rep.*, 4** (10), Pp 7.

Received: September 29,2019

Accepted: October2, 2019

Published: October 4, 2019

Corresponding author
Atsor Christopher Terna
chrisatsor@gmail.com

Atsor Christopher Terna[1] and Manguts Yabans Sundung[2]

Centre for Food Technology and Research, Benue State University, Makurdi, Nigeria.
Food and Strategic Reserve Federal Ministry of Agriculture, Makurdi, Nigeria.

ABSTRACT

Harvested tomatoes, like every other fresh horticultural crop are living products. They are characterised by tender nature, high moisture content, active metabolism and are rich in nutrients. These make them vulnerable to dehydration, environmental stresses, mechanical injury, physiological disorders, and pathological breakdown. Their spoilage therefore occurs at any point from harvest to utilisation resulting to reduced shelf-life and losses along the Postharvest chain. Harvesting and postharvest handling practices like cleaning, sorting, packaging, transportation; storage and marketing play significant roles in either aggravating or minimizing these losses. Significant losses of tomatoes are recorded in Benue state during production seasons as a result of inappropriate handling practices and lack of storage and processing facilities. To help minimize these losses, understanding the causes of deterioration in fruits and vegetable is a fundamental step followed by adoption of appropriate postharvest practices. This paper reviews the current postharvest handling practices of fresh tomatoes in Benue state and suggests how they can be improved. These include harvesting at appropriate level of maturity, good sanitation, careful handling to reduce mechanical injuries and protection from microbial contamination and harsh weather conditions. Value addition through processing, provision of storage and preservation facilities are recommended as long lasting measures.

Keywords: Post-harvest Losses, Handling Practices, Tomatoes, Value addition

INTRODUCTION

Post-harvest begins at the moment of separation of the edible commodity from the plant that produced it by a deliberate human act with the intention of starting it on its way to the table. The post-harvest period ends when the food comes into the possession of the final consumer. The term "postharvest loss" - PHL refers to measurable quantitative and qualitative food loss in the postharvest system (Kader, 2002). This system comprises inter connected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food.

Postharvest losses of food commodities are becoming a source of concern globally as food insecurity threatens the nations, most especially the developing African countries like Nigeria, where postharvest losses of particularly horticultural crops like fruits and vegetables are high (FAO, 2008).In some African, Caribbean and Pacific ACP countries, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can regularly be as high as 40-50% (FAO, 2015).

Tomato (Solanum lycopersicum) which belongs to the nightshade family, Solanaceae originated from the Andes, in what is now called Peru, Bolivia, Chile and Ecuador - where they grew wild. They were first cultivated by the Aztecs and Incas as early as 700 AD. Its use as a food originated in Mexico, and spread throughout the world following the Spanish colonization of the Americas. The tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salads, pastas, pizzas, ketchup, various beverages, and as an included flavour element in dishes from breakfast to dinner and drinks. While tomatoes are botanically and scientifically the berry-type fruits of the tomato plant, they can also be considered a culinary vegetable. Daily consumption of tomatoes provides a great boost to health, along with improving the flavour of food. Tomato and tomato-based foods provide a wide variety of nutrients and many health-related benefits to the body including aiding digestion, improving vision, preventing gallstones and urinary tract infections, lowering hypertension and reducing oxidative stress of type 2 diabetes (Wiicox et al 2003). Tomato contains higher amounts of lycopene, a type of carotenoid with antioxidant properties which is beneficial in reducing the incidence of some chronic diseases] like cancer and many other cardiovascular disorders (Arab and Steck 2000).Tomatoes are relatively easy to cultivate and grow very quickly, making them a quickly replaceable food source, which is a big reason why it is a staple food for many nations. Nowadays, tomatoes are grown in countries all around the world.FAO Statistics released in 2015 reveals that China is the world largest producer of tomatoes accounting for 31% of the 163.4 million tonnes of world's total production in 2013 followed by India, the United States, Turkey and Egypt in that order. The same records show that Nigeria is the 14th largest producer of tomatoes in the world and ranks 2nd in Africa after Egypt.There are several varieties and cultivars of tomatoes in cultivation today including Cherry, Roma or Bangalore (Indian hybrid), heirloom, Brandywine, Black Krim etc.Benue state has been named the 'Food Basket' of the nation. It is particularly noted for high production of fruits and vegetables including pepper. Though there are no reliable statics, a survey of production areas and consumer markets across the state shows that significant losses of tomatoes are incurred especially during the cropping season.

Most farmers raise nurseries of the crop during the dry season and transplant onto the farms at the onset of rains around March or April and so between the months of July to September the harvested produce flood the markets throughout the State with farmers marketing the produce directly to consumers, wholesalers and retailers. So much tomato is produced during the season beyond the local consumption need of the state and market demand. Lack of storage or preservation facilities and processing factories lead to losses during the production period as tomatoes are highly perishable and deteriorates fast if kept ordinarily.

Causes of post harvest losses of fruits and vegetables are many and commodity specific since horticultural products are diverse in morphological structure, composition, development and general physiology. Kader (2002) identified continuous metabolism and growth, water loss,

physiological disorders, mechanical damage and pathological breakdown as the main causes of deterioration of fresh horticultural produce. The matter is made worse by poor handling practices on the part of all the people involved in the post harvest chain including farmers, transporters, and marketers. These practices have serious effects on the quality of produce sold in the markets and its shelf life as highlighted below.

HARVESTING PRACTICES

Maturity at harvest time

The physiological maturity of any fruit at harvest has an important effect on postharvest quality of that fruit (Beckles 2012). Therefore, care must be taken as to when to harvest the fruit in order to attain the best quality. The shelf life of fruits and vegetables is described by postharvest physiologists in three stages: the maturation, ripening, and senescence stages. The maturation stage gives an indication of the fruit being ready for harvest. At this point the edible part of the fruit or vegetable is fully developed in size, although it may not be ready for immediate consumption. Ripening refers to the developmental phase spanning from the last stage of maturation through the earliest stage of senescence. This phase is usually characterised by breakdown of cellular integrity of tissues, several biochemical and physiological activities involving change in colour, flavour, firmness and aroma (Mohammed et al., 2011). Senescence refers to the stage when deterioration sets in. The stage is characterised by natural degradation of the fruit or vegetable, as in loss of texture, flavour etc and ends at the death of the tissues of the produce. Due to ripening behaviour, fruits have been classified into climacteric and non-climacteric fruits (Barry and Giovannoni 2007). Climacteric fruits ripen normally even after harvest at mature stage due to continuous production of ethylene which is a ripening agent while non-climacteric fruits do not. Non-climacteric fruits can therefore be harvested only when they are fully ripeTomatoes can be harvested in either matured green, partially ripe, or ripe state. Tomato being a climacteric fruit can be harvested at the matured green state allowing ripening and senescence to occur during the postharvest period of the fruit. Fully ripened tomatoes are susceptible to mechanical injuries during harvesting resulting in shorter shelf life (Toivonem 2000, Arah 2015).

Most Benue farmers harvest their tomatoes when the fruits are fully ripe with the colour completely changed from green to red or golden yellow depending on the variety. At this stage of maturity

i. The produce is very soft and less resistant to mechanical injury. The fruits are easily bruised, squeezed or ruptured during the process of packing for bringing back to the house or for transport to the markets. This damage reduces the quantity of wholesome produce for marketing resulting to economic losses.
ii. The damaged produce also oozes water resulting to wilting and shrivelling. The squeezed water also mixes with even the undamaged fruits and the watery medium promotes the growth of moulds and other spoilage organisms resulting to reduced shelf life. Also as the water dries on the surfaces of the fruits their shiny appearance becomes dull and they become sticky to touch. Their marketability is therefore affected.
iii. The rate of chemical and biochemical processes are at their peak such as enzyme activities and respiration. These hasten the process of senescence and the shelf life of the produce is shortened.

Cleaning of harvested fruits

Cleaning of fruits and vegetables is a critical post harvest practice. The main aim of cleaning is to provide customers with product that is attractive and clean with minimum risk of microbial

contamination. But beyond this aim, products contaminated with spoilage organisms spoil faster and can become a source of food-borne diseases. Studies have implicated tomatoes as one the food produce that transmits food borne diseases like salmonella (Guo et al 2001). Unfortunately, cleaning or disinfecting tomatoes after harvest is not a common practice for most tomatoes handlers in developing countries especially those from Africa. This practice may be attributed to either the unavailability of portable water at the production sites or the sheer ignorance of the practice. Tomato plants in Benue state are not staked so the fruit are in contact with the soil. At harvest most of the fruits are contaminated with sand and soil microorganisms. These are packed along with produce without washing and the moulds grow quickly in package containers resulting to reduced shelf life. Apart from not washing the produce, the packing containers which are mostly baskets are not washed and because of repeated usage they become a source of contamination of produce.

Harvesting time

Tomatoes are also harvested at any time of the day including afternoons when temperatures are high. The produce is therefore packed in containers at these high temperatures. At these high temperatures, respiratory rate and enzymes activities are heightened resulting to fast deterioration of the produce.

Packaging practices

Packagingis enclosing food produce or product to protect it from mechanical injuries, tampering, and contamination from physical, chemical, and biological sources (Prasad, P and Kochhar, 2014). Some common packaging materials used in most developing countries include wooden crates, cardboard boxes, woven palm baskets, plastic crates, nylon sacks, jute sacks, and polythene bags.

Packaging from the farms

During harvesting on the farms, buckets, plastic basins, baskets and other containers are used. The containers are used repeatedly without washing and hence the produce is contaminated with spoilage organisms.

Packaging for sale

Small sized baskets are almost exclusively used as packaging materials by farmers. The baskets are made from bamboo, rattan, straw, palm fronds, etc. Like the containers used in packing the produce from the farms, these baskets are used repeatedly without washing them. Grasses or straw are used primarily to cushion the product from mechanical injury during transport. Both the grasses and the reused baskets are sources of contamination of the produce. Other disadvantages of these packaging materials include:

i. they are difficult to clean when contaminated with decay organisms
ii. they lack rigidity and bend out of shape when stacked for long-distance transport
iii. they load badly because of their shape
iv. they cause pressure damage when tightly filled
v. they often have sharp edges or splinters causing cut and puncture damage
vi. When fully packed and covered, air circulation in the produce is prevented. This affects the respiration process of the material. Inadequate air circulation also results in build up of CO_2 causing fermentation and development of off flavours.
vii. Heat build-up in the packaged produce also hastens the rate of deterioration.

Transportation practices

Transportation of harvested tomato from the farms to markets is a major challenge as roads linking the hinterlands to urban centres where the produce is sold are mostly bad. Much produce

is conveyed in overloaded rickety vehicles. Baskets are stacked on top of others causing crushing damage due to pressure build up. Farmers are conveyed along with the produce. Vibrations caused by speeding on the rough roads, impact of loading and offloading, rough handling on wheel barrows from the vehicles to the stores or open markets etc make the damage worse. By the time produce arrive the markets most of the fruits are already broken with water spilled on surfaces of even the unbroken ones as the produce was already ripe and soft at the time of harvest. The damage caused by poor packaging mentioned above is worsened during transportation.

Marketing

Marketing of tomatoes in Benue State is essentially through wholesale and retail outlets in open markets. Upon arrival in the markets, farmers display the produce in baskets brought from the farms in the open sun uncovered. As a marketing strategy some wholesome fruits are selected and put on the surface of the containers while the inner contents are of varying qualities with some of them already damaged in transit.

Traders buy the produce from the farmers for sale in other locations or states while retailers who buy from farmers display the produce in small units on tables or spread on trays for sale to home users or caterers. Both farmers, wholesalers and retailers, leave the produce under the sun with little or no shade provision. This direct exposure increases the temperature of produce and hastens the rate of water loss and deterioration.

Practical ways for improving the handling of tomatoes to increase its shelf life

The practical ways of improving the shelf life of tomatoes are essentially improvements in the harvesting, handling, transportation and marketing practices.

Harvesting

i. Make successive plantings and use several varieties of varying maturity to spread the harvest season. This ensures that freshly picked material will be available over an extended period.

ii. Provide gentle harvesting and handling to avoid cuts, abrasions, and bruising damage that allow decay-causing micro organisms to enter the tissue.

iii. Tomatoes should be reaped with calyx intact. When calyx is removed, the fruit can be infected easily by pathogens, thereby reducing the quality and shelf life of the product

iv. Harvest produce at the peak of quality. This assures greatest value at the time the commodity begins a sales period or storage period for later sale. Because most produce begin to deteriorate at the time of harvest, the highest-quality produce will have the greatest shelf life. Harvest when the produce is mature green so that the process of ripening will be completed during transportation and marketing.

v. If possible, harvest during the cool part of the day. Temperature controls the rate at which produce deteriorates. Harvesting when the produce is coolest (usually just after sunrise) or in the evening will extend their shelf life.

vi. If storage facilities are not available, harvest only as much produce at one time as you can pack or sell before the quality deteriorates. This also allows displays at roadside markets to be replenished with freshly harvested produce throughout the day, which ensures highest quality available to customers.

vii. Hold produce in a shaded area while awaiting packing. Perform sorting and packing operations in a shaded location. Shade may be provided by putting a shade cloth over a simple framework, or even by a large tree.

viii. Sorting is necessary before packing. Remove fruits with growth cracks, harvest injuries, insect damage, discoloured or fruits with fungus, immature fruits, and over ripped fruits as they will deteriorate faster.

ix. Rid produce of surface contamination by thorough washing of fruits and packing containers.

Transportation

i. Use rigid packaging materials that can withstand vibration forces and also protect produce from crushing and bruising. Wooden boxes and plastic designed to stack on top of each other without crushing the produce are recommended. The containers must have vents for air circulation as the produce still respires after harvest.

ii. Careful handling during loading and offloading of produce from vehicles

iii. Produce should be transported in refrigerated vans at temperatures that will not hasten deterioration. But where this is not available an opened body truck covered with light coloured tarpaulin can be used.

iv. Opened body vehicle should travel in the cool of the day so as to prevent the built up of field heat. The vehicle should have enough space so as to provide proper and adequate ventilation.

v. Careful driving can also reduce the impact of vibrations and reduce mechanical injuries.

vi. Pre-cooling of produce before transporting them is also essential.Fruit is pre-cooled when its temperature is reduced and is cool enough for safe transport. At the level of farmers, leaving harvested produce under open shades for sometimes before packing in containers can reduce its temperature. Pre-cooling may be done with, cold water (hydro-cooling), direct contact with ice, or evaporation of water from the surface of fruits. Farmers, retailers and wholesalers can help in extending the shelf life of produce by imbibing good handling practices during marketing including:

   a. Taking care to avoid bruising of produce.
   b. Frequent sorting to remove over-ripped, rotten and poor quality material from wholesome ones to reduce contamination and deterioration.
   c. Not displaying produce in the open sun but keeping them in cool stores or shades to maintain a reduced temperature and prevent loss of water from their surfaces that could result to wilting and shrivelling.

SUGGESTIONS FOR MORE SGNIFICANT REDUCTION OF POST HARVEST LOSES IN BENUE STATE

Tomatoes are delicate and highly perishable. The measures suggested above for farmers transporters and marketers can help in reducing post harvest losses of fresh tomatoes to a very limited level. So the major significant step to reduce post harvest losses of tomatoes is for government, individuals and corporate investors to:

i. Provide refrigerated vans for transportation at low temperatures.

ii. Develop infrastructural facilities like good access roads for easy and timely evacuation of farm produce from rural farming settlements to urban centres where there is ready market for them.

iii. Empower farmers through financial grants, soft loans and subsidised farm inputs to enable them acquire modern farming equipments.

iv. Establish fresh produce commodity board with the capacity to buy from farmers and market the produce locally and internationally.

v. Build refrigerated stores, cold rooms and controlled atmosphere facilities in the state for prolonged storage of the produce beyond production season.

vi. Embark on **Value Addition**. Value addition is a terminology used to define the processing of biological produce. Through processing the value of the commodities can be increased by converting it to different products by using conventional or modern processing techniques, thereby the storage life of the produce is enhanced. Processing factories that will add value to tomato produce by converting them into more stable products like tomato paste, puree and ketchup should be built.

CONCLUSTION

Tomato farming in Benue state is seasonal but is fast becoming popular among rural dwellers in the state and the need to deliver freshly harvested tomatoes to urban centres for sale in their best quality at higher prices becomes imperative. Only improved postharvest handling practices by all stakeholders in the marketing chain can guarantee high returns on the financial and labour investments in tomato farming. There is also the dire need for government to shift from mere lip-service on agricultural issues to practical steps that would bring the desired impact. Value-addition becomes the best option in this circumstance.

REFERENCES

[1]. Arab, L.; and Steck, S. (2000) "Lycopene and cardiovascular disease," *The American Journal of Clinical Nutrition,* vol. 71, no. 6, pp. 1691–1695

[2]. Arah, I. K. (2015) "An overview of post-harvest challenges facing tomato production in Africa," in Africa: Diversity and Development, 37th AFSAAP Conference Proceedings, AFSAAP, pp. 1–21.

[3]. Barry, C.S. and Giovannoni, J.J. (2007). Ethylene and fruit ripening. *Journal of Plant Growth Regulations* 26:143-159.

[4]. Basu, A. and Imrhan, V. (2007) "Tomatoes versus lycopene in oxidative stress and carcinogenesis: conclusions from clinical trials," European Journal of Clinical Nutrition, vol. 61, no. 3, pp. 295–303.

[5]. Beckles, D. M. (2012) "Factors affecting the postharvest soluble solids and sugar content of tomato (Solanum lycopersicum L.) fruit." Postharvest Biology and Technology, vol. 63, no. 1, pp. 129–140.

[6]. Burton-Freeman, B. and Reimers, K. (2011) "Tomato consumption and health: emerging benefits," *American Journal of Lifestyle Medicine,* vol. 5, no. 2, pp. 182–191.

[7]. FAO (2008) Basic harvest and post-harvest handling considerations for fresh fruits and vegetables handling and preservation, FAO, Rome, Italy.

[8]. FAO STAT (2015) Global tomato production in 2013,UN Food and Agricultural Organization Statistics Division. Retrieved 3rd June 2016

[9]. Guo, X., J. Chen, R.E. Brackett and L.R. Beuchat.(2001). Survival of Salmonellae on and in tomato plants from the time of inoculation at flowering and early stages of fruit development through fruit ripening.*Appl. and Env. Microbiol*. 67(10): 4760-4764.

[10]. Idah, P. A. Ajisegiri, E. S. And Yisa, M. G. (2007). "Fruits and vegetables handling and transportation in Nigeria," *AU Journal of Technology*, vol. 10, no. 3, pp. 175–183.

[11]. Kader, A. A.(2002) Postharvest biology and technology: an overview. P.39-47. In: Kader, A. A. (ed). Post harvest Technology of Horticultural Crops. (3rd ed).University of Califonia, Agriculture & Natural Resources.

[12]. Muhammad, R. H., Bamisheyi, E. and Olayemi, F. F. (2011) "The effect of stage of ripening on the shelf life of tomatoes (Lycopersicon esculentum) stored in the evaporative cooling system (E.C.S)," *Journal of Dairying, Foods & Home Sciences,* vol. 30, no. 4, pp. 299–301.

[13]. Prasad, P and Kochhar, (2014). A "Active packaging in food industry: a review," *Journal of Environmental Science, Toxicology and Food Technology,* vol. 8, no. 5, pp. 1–7.

[14]. Toivonen, P. M. A. (2007) "Fruit maturation and ripening and their relationship to quality," Stewart Postharvest Review, vol. 3, no. 2, 5

[15]. Willcox, J. K.; Catignani, G. L.; and Lazarus, S.(2003) "Tomatoes and cardiovascular health," Critical Reviews in Food Science and Nutrition, vol. 43, no. 1, pp. 1–18.