# Indigenous Post-Harvest Technologies for Fruit Crops Evidence from Federal Institute of Industrial Research, Oshodi, Lagos

**BY**

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## ABSTRACT

Fruit crops spoil easily. This reduces their quantity and quality available for human and industrial consumption. Inadequate storage and processing facilities partly aggravate the challenge despite available technologies for post-harvest handling of agricultural products in Nigeria. The study therefore examined the indigenous post-harvest technologies for fruit crops handling by the Federal Institute of Industrial Research, Oshodi, Lagos (FIIRO). Nigeria established FIIRO in tandem with triple helix principle of the interrelationship between science, technology and innovation institutions, users of technologies and government. The study adopted interview of relevant FIIRO's staff and content analysis of the institute's documents and website to examine its fruit crops post-harvest technologies. Data are presented using pictorial graphics, slides and tables. FIIRO has developed post-harvest technologies for fruits crops. The technologies included metal silos, tomato grader sorting lines, ultrasonic washer, evaporator, fruit juice making machine, fruit washing machine and cabinet dryer. The technologies are easy to operate, specialists are available to repair them but they are costly for an average farmer and fruits marketer to afford. For effective usage of the technologies, the fruits should be assessed at maturity stage for ripening for harvesting. Injury of the fruit crop during harvest should be avoided to guide against loss. Storage area should be separated from the processing area and bruised fruit should be separated from the whole fruit. Government should promote awareness and support mass production of the post-harvest technologies to reduce unit cost and make them cheap to end users.

**Keywords:** Fruits, Lagos, Post-harvest, Technology and Innovation institute.

## INTRODUCTION

Total fruit and vegetable production in the world was estimated to be 910 million tonnes in 2021 (FAO, 2022) and its post-

harvest losses ranges from 25 to 50% (Bancal and Ray, 2022). This negatively affects the availability of fruits and vegetables to human and industrial consumers. Fresh fruits and vegetables are perishable and get spoilt due to their high water contents, which encourages the attack of micro-organisms. This situation is a challenge to nutritional, health and economic needs of the populace as fruits and vegetables possess vitamins and minerals. They contain ingredients that normalise and catalyse digestion through the regulation of acidity level of the small and large intestines (Ibeawuchi et al., 2015). Fruits and vegetables production and marketing, like every other economic production activities, are sources of income, job and wealth creations in both the rural and urban areas.

Fruits and vegetables belong to the horticultural subsector of agriculture. Many initiatives have been applied to improve the subsector but it still remains under-developed. The horticultural sub-sector shows the challenges of the whole agricultural sector. The challenges, however, are not limited to poor production, marketing technologies and inadequate extension, but are related to non-availability of improved indigenous post-harvest technologies. Effective and efficient post-harvest technologies can reduce the quantitative and qualitative loss of fresh fruits and vegetables as well as maintain the product quality up to final consumption (Singh et al., 2014). All agricultural products require appropriate handling from harvesting to the table of the consumer. Fruit crops include citrus, pineapple, mango, plantain, banana, while vegetables include tomatoes, pepper, and melon.

Aside solving the problems of food and raw material shortages and malnutrition, the establishment of industries that deal with fruits and vegetables will stimulate production, open new opportunities for investment and improve rural income. The industries will boost fruits conservation and processing through post-harvest technologies. Post-harvest technologies refer to innovative systems for handling subsequent processes done immediately after removing a plant or part of a plant from its growth medium to the point at which the final consumer receives it in the desired form. Post-harvest technologies are inventions that improves the value chain concept that can consist of functions and activities that may include assembly, sorting, cooling, cleaning, preservation, packing, packaging, on or off-farm processing and/or transportation to the wholesale, retailer and consumer (Adewoyin et al., 2022).

Due to the foregoing, the paper examines indigenous technologies that have been developed to reduce post-harvest losses of fruit crops by a typical Nigerian research institute, the Federal Institute of Industrial Research Oshodi, Lagos (FIIRO). FIIRO was chosen for this study due to its mandate that entails accelerating the industrialization of the Nigerian economy through identifying and characterizing local raw materials for use in industries, developing appropriate technologies; upgrading indigenous technologies in the area of food and agro-allied processing and in various non-food items, developing pilot scale operations, assisting in the transfer, adaptation and utilization of these technologies by local enterprises, and undertaking economic evaluation of projects and consultancy services (FIIRO, 2024).

Nigeria promotes production and consumption through the triple helix model of linkage and processes between science, technology and innovations institutions (STI), users of technologies and government.

FIIRO belongs to STI established by the government to provide innovative solutions to agricultural product's post-harvest challenges to enhance their human and industrial consumption. It is therefore necessary to add to literature some of the technologies that the institute has developed over time.

## METHODOLOGY

Purposive sampling was adopted. The study was conducted at the Federal Institute of Industrial Research, Oshodi, Lagos, Nigeria. Interview was conducted on selected researchers in 6 departments of FIIRO, namely, Food Technology (FT), Project Development and Design (PDD), Biotechnology (BD), Chemical, Fiber and Environmental Technology (CFET), Production, Analytical and Laboratory Management (PALM) and Planning, Technology Transfer and Information Management (PTTIM). Content analysis of institute documents and website was done to examine the available post-harvest technologies for fruit crops. Data is presented using pictorial graphics and tables.

## 3 RESULTS AND DISCUSSION

### 3.1 FIIRO's Technologies for Fruit Crops Post-Harvest Losses Reduction

A number of technologies have been developed by FIIRO including metal silos, plastic basket, threshers and harvesters, ranging from manual to motorized operating systems. Nine other technologies are shown as Figures 1 to 9 and their description and uses are contained in table 1.


Fig. 1: Tomato grader sorting lines

Fig. 2: Heat pump machine

Fig. 3: Ultrasonic washer

Fig. 4: Hot break tank

Fig. 5: Positive Displacement Pump

Fig. 6: Evaporator

Fig. 7: Fruit juice making machine

Fig. 8: Fruit washing machine

Fig. 9: Cabinet dryer

Table 1: FIRROs' technologies for fruit crops post-harvest loss reduction

| Figure | Name | Description | Use(s) |
|---|---|---|---|
| 1 | Tomato grader sorting lines | Designed to prevent the overloading of more than one tomato on the same trolley and to maximize the line filling | Sorting tomatoes by sizes |
| 2 | Heat pump machine | For transferring thermal energy from a cooler space to a warmer space using the refrigeration cycle, moving heat in the opposite direction in which heat transfer would take place without the application of external power. | Used to heat or cool an enclosed space or domestic water |
| 3 | Ultrasonic washer | Ultrasonic cleaning submerges the items within a bath of water, allowing all areas of the item to be deep-cleaned. | Used in cleaning of tomatoes, within the ultrasonic cleaner, wherever the water touches, ultrasonic action is taking place.<br>Deep Clean multiple items at once. |
| 4 | Hot break tank | Keeps the sauce from separating during storage and improving other aspects of product quality. The tank requires no water inputs, and has been designed to use minimal steam energy | Used to de-activate the pectnase enzymes present in tomatoes. |

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|---|---|---|---|
| | | for processing. All products is then pumped to the pulper/finisher | |
| 5 | Positive displacement pump | High-efficiency motors were selected to ensure minimal energy use. | Used to transfer viscous product from one processing stage to another. |
| 6 | Evaporator | A system that will operate under a vacuum, which lowers the boiling point of the sauce under $14^0$F ($-9^0$C). This will lower energy input greatly, with the added bonus of allowing re-capture of the boiled off water. In a typical 1000-1500 lb. batch of tomatoes, 50-75 gallons of water will be captured, enough to clean the equipment used up to this point. It is a great improvement over the typical piece of equipment used in this process. | Used to concentrate the tomato juice into a tomato sauce. Typical evaporation processes require boiling at 250F and the evaporated water is released to the atmosphere, easily making this the most wasteful and energy intensive portion of the process |
| 7 | Fruit juice machine | Squeezing fruit or vegetables into fruit juice by mechanical means. | Making fruit juice |
| 8 | Fruit washing machine | Product is dumped into the washer where an air blower attached to the unit will agitate it and strong water spray then washes it. The product is subjected to four washing stages | For washing the various fruits like mango, guava, papaya, etc |
| 9 | Cabinet dryer | Inexpensive and simple to construct. Cabinet dryers consist of a closed compartment in which trays containing the food to be dried are placed | For batch drying of solid foods at small to moderate scale (2000 to 20 000 kg per day). |

Sources: FIIRO (2022 & 2023)

The indigenous technologies are available, easy to operate and specialists are available to repair them, but their unit prices are too costly for average farmers and fruit marketers to afford (Ior and Leo, 2023). Cost of indigenous post-harvest technologies has been established to influence user's choice of acquisition and can inhibit their usage (Adejumo et al., 2020, and Muganyizi and Rejikumar, 2023). Other main barriers to the usage of available indigenous postharvest technologies are unavailability within the locality and lack of awareness of the technologies (Muganyizi and Rejikumar, 2023). By the triple helix principle, government has set up FIIRO and the research institute is fulfilling its mandate by producing indigenous technologies for the use of economic agents like farmers and farm products marketers. It is necessary for government, however, to carry out the census of usage spread of all the indigenous technologies that have been developed by FIIRO in the country. This will give the government the desired feedback for the purpose of enhancing the applications of the indigenous technologies for agricultural

transformation which is a spring board for economic transformation.

To benefit from the applications of the FIIRO's technologies, the first step in post-harvest handling is that the fruits should be assessed at maturity stage for ripening. Secondly, farmers and agricultural products marketers are to avoid injury of the fruit crop during harvest and post-harvest handling to guide against loss. Then, post-harvest fruit handlers should ensure that the storage area is separated from the processing area and separating damage/ bruised fruit from the whole fruit. The choice of post-harvest technology to use will essentially depends on circumstances like the scale of production, fruit crop type and the user's affordability and willingness to pay. The post-harvest technologies described need to be developed further with fusion of modern-day technologies without making the product to lose its natural food components. The technologies should be environmentally friendly mitigating climate change, conserve biodiversity and be energy saving to be cost effective operationally in line with Masarirambi (2010).

## CONCLUSION AND RECOMMENDATIONS

Post-harvest fruit crops handling is of great interest to STI institutions because of its importance for making the fruits available for human and industrial consumption. FIIRO has developed a number of post-harvest technologies for fruit crops. The study recommends that government should financially support mass production of the post-harvest technologies to reduce the unit cost and create awareness for them. In this connection, the local steel industry needs be resuscitated for the production of the steel components of the local technologies. Government should do an enumeration of usage spread of FIIRO's technologies to get feedback for the purpose of boosting their application in agricultural marketing activities. Also, the decision of the Nigerian government to establish agricultural processing and storage hubs in the country should be implemented effectively without delay to boost the application of some of the indigenous technologies for post-harvest loss reduction.

## ACKNOWLEDGEMENTS

The authors appreciates attendees .of the parallel session in which the paper was presented at the 36th Farm Management Association of Nigeria (FAMAN) Conference (FAMAN – LAGOS-2024) that contributed towards making the article better in form.

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