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Effectiveness of Zero Energy Cooling Chambers by Tomato Marketers in Ogun State

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Abstract
The need to enhance the storability and the shelf life of tomato fruits brought about the development of zero energy cooling chambers (ZECC) for the use of tomato value chain actors. In view of this, this study evaluated the effectiveness of three different types of zero energy cooling chambers (ZECC) by tomato marketers in Ogun State. Structured interview schedule was employed to obtain primary data from 80 tomato marketers' selected using multi stage sampling procedure. Data were analyzed using descriptive statistics. Results showed that all (100%) the sampled marketers were females. The mean age was 41.9 years marketers, 98.8% of the marketers were married while 55.0% of the marketers had primary school certificate. All (100%) the marketers stored tomato using open shelf and all (100%) the marketers were not aware of the zero energy cooling chambers. All the marketers (100%) adjudged the brick-in-brick, pot-in-pot, tin-in-pot effective for maintaining fruit firmness, fruit colour, quality and shelf life extension. However, less than 5.0% of marketers are of the opinion that brick-in-brick and pot-in-pot were ineffective for reducing disease incidence. The study concluded that there is low level of awareness of ZECC and that the tomato marketers adjudged the ZECC as effective. It was therefore recommended that steps should be taken towards creating a nationwide awareness about the ZECC and also making the resources for constructing ZECC be made available.
Keywords: Tomato, Post-Harvest, Effectiveness, Marketers, ZECC, Packaging.

INTRODUCTION

Fresh fruits and vegetables are very important sources of vitamins and minerals which are essential for human health. Tomato (*Lycopersicom esculentum*) is a staple fruit vegetable and one of the most important cash and industrial crops in many parts of the world (Babalola e*t al.*, 2010). Tomatoes are grown either for fresh market or for processing purposes. They are important in food industry as they serve as raw materials for production of value added products. Tomatoes may be pressed into pastes or puree which is used for cooking and in the production of fruit drinks (Babalola *et al.,* 2010). It is consumed in every home in different ways, such as vegetable, salad, ketchup. Due to population increase, the domestic consumption and demand for tomato is growing.

Produce shelf life could be extended either for fresh market consumption or for further processing into puree or paste depending on the intended market. Several improved handling and storage technologies have been investigated and proven to extend the shelf life of tomato produce. Preservation is a key issue for food security, even when farmers and small-scale producers produce a healthy crop; they still face the problem of loss because of improper handling, packaging and preserving techniques used for the fruit and vegetables. In order to extend the shelf-life of vegetables, Wills *et al.*, (1999) recommended that farm produce should be stored at temperature of 4-10^{0}C. For fruits and vegetables that deteriorate quickly, modified or controlled atmosphere storage is a useful technique for extending shelf-life (Sánchez-Mata *et al.,* 2003).

Several storage structures have been recommended, for example, the Nigerian Stored Products Research Institute (NSPRI) developed some zero energy cooling chambers for storing highly perishable horticultural produce (NSPRI 1990). The structures may be in form of brick-in-brick, pot-in-pot, block-in-block, tin-in-pot or pot-in-block. These structures provide a cool environment for fruits and vegetables stored in it. This study is guided by the following objectives:

i. describe the socio-economic characteristics of the tomato marketers in the study area;
ii. identify the storage facilities used by tomato marketers in the study area;
iii. examine tomato marketers level of awareness of zero energy cooling chambers;
iv. determine tomato marketers' assessment of zero energy cooling chambers

METHODOLOGY

The study was conducted in Ogun State, Nigeria, Ogun State covers a land area of about 16,409.26 square

kilometers with a population of about 3,729,098 people (NPC, 2006). The state is structured into twenty local government areas and is largely dominated by the Yoruba speaking tribe. It has a bimodal rainfall pattern that reaches the peak in July and September (Aderibigbe, 1994) and it comprises mostly agrarian communities, which engage in farming activities including the production of both cash and food crops in which tomato is one to meet the livelihood needs of the farmers.

The study population was composed of tomato marketers in the selected area of Ogun State, Nigeria. A multi stage sampling technique was used in selecting markets and marketers. Of the twenty local government areas in the states, two was purposively selected Obafemi/Owode and Abeokuta South local government area. Two markets were purposively selected from each of the selected local government area, the selected markets include Olomore, Siun, Kuto, and Oba. Twenty marketers were selected from each of the markets selected. A total of 80 marketers formed the sampled size. Data were collected through the use of structured interview schedule. Data were analysed using descriptive statistics such as percentages; mean, frequency distribution was used to summarize the data.

RESULTS AND DISCUSSION

Socio-economic characteristics

Table 1 revealed that all the sampled marketers (100%) were female with Majority (98.7%) of marketers falling within the age range of 31-50 years which was reported to be the age range of young and economically active people (FAO, 1997). The mean age of the marketers was found to be 44.9 years. Further revealed on Table 1 was that more than half (55.0%) of the marketers had completed their primary school education before venturing into tomato marketing. the result on the table shows that 98.8% of the tomato marketers were married with 66.3% of them having a manageable household size of about 1-5 persons which is an indication that the tomato marketers have sufficient people who could assist in marketing activities and other household chores. On years of marketing tomato, The result reveals that most (61.4%) of marketers had between 6-20 years of marketing tomato, the respondents mean years of experience was 20.63 years. This implies that the sampled marketers are experienced and skill-ful actors who can successfully manage and handle tomato through the chain of production before getting to the final consumer. Ige (2011) findings corroborate this that the longer a person consistently practiced or carried out a task the better the level of competency developed to successfully and skillfully handle the task. Above half of the marketers (53.8%) purchased less than 50 baskets per market day while the remaining 46.2% purchased more than 50 baskets. This implies that majority of the tomato marketers are wholesalers. The retailers sell more than 50% of their purchases within the same markets leaving the rest to be opened to deterioration caused by lack of storage facilities. From the quantity purchased, 54.0% of this marketers make an income less than N50, 000 from tomato after it has been sold while 46.0% of them make above N100, 000. This implies that almost half of the marketer's income maybe sufficient for them and families without venturing into other sources of livelihood.

Tomato marketers post-harvest storage facilities

Table 2 showed that 100% of marketers use the open shelf method of storage. This method which involves marketers spreading tomato fruits on the floor or keeping in basket where there is proper ventilation. It is in agreement with Kutama, *et al* (2007), who highlighted that tomato fruits are stored and conveyed in traditional weaver wicker baskets (woven baskets). The use of refrigerator is totally lacking among tomato marketers because of the epileptic power supply situation in the country, many of them may not be able to afford to buy refrigerator to use for storage.

Awareness of zero energy cooling chambers

The tomato marketers are not aware of the zero energy cooling chambers which implies that the facilities have not been popularized among the marketers in the study area. Table 3 revealed that all (100%) the tomato marketers have never heard about any of the zero energy cooling chambers. The low level of awareness may be as a result marketers lack of knowledge on the principle and practices of post-harvest that could help reduce losses as well as extend the shelf life of the produce and non-promotion of proven on-station research output from agricultural institutions. It could also be due to challenges of disseminating technologies into the hands of the stakeholders that need it most and may include the ineffectiveness and poor extension system for post-harvest technologies in Nigeria.

Tomato marketers' evaluation of zero energy cooling chambers

Tomato marketers evaluated the three types of Zero Energy Cooling Chamber based on post-harvest characteristics of tomato stored and handled with them. The characteristics used in evaluating include the ability to maintain fruit firmness and fruit colour overtime, ability to extend shelf life and reduce disease incidence, maintenance acceptable tomato fruit quality for marketers and consumer. Table 4 revealed that all the tomato marketers (100%) adjudged the brick-in-brick, pot-in-pot effective for maintaining fruit firmness, fruit colour, quality and shelf life extension. However, 3.8% of marketers are of the opinion that brick-in-brick is ineffective for reducing disease incidence. Likewise, 5.0% of marketers assessed pot-in-pot to be ineffective for reducing

disease incidence. Few (6.3%) of the marketers said that tin-in-pot is not effective for maintaining firmness while all (100%) the tomato marketers said it is effective for maintaining fruit colour. All (100%) the marketers assessed the tin-in-pot as effective for fruits shelf life extension and quality maintenance while 88.8% of marketers said it is only effective for reducing disease incidence. This implies that the zero energy cooling chambers were effective as adjudged by the tomato marketers.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it was concluded that tomato marketers were not aware of the different types of zero energy cooling chambers. This implies that they were not aware of the effectiveness of the facilities. This low level of awareness could be as a result of the poor extension system of tomato post-harvest practices in the country. Upon completing the study, it was also concluded that tomato marketers adjudged the ZECC as effective for maintaining fruit firmness and fruit colour overtime, ability to extend shelf life and reduce disease incidence, maintenance of acceptable tomato fruit quality for marketers and consumer. Based on the findings of the study, the following recommendations were therefore suggested that steps should be taken towards creating a nationwide awareness about the zero energy cooling chambers and improved post-harvest packaging facilities especially to areas where tomato are produced and marketed. Awareness about the ability to extend shelf life as well as still maintains quality over the local method should also be created among tomato value chain community as well as the consumers. This will help in creating an enabling environment for marketing tomato handled and stored using these improved facilities. Furthermore, resources for construction of pot-in-pot, brick-in-brick and tin-in-pot should be made available at an affordable rate to the tomato value chain communities that have decided to adopt the storage facilities as adoption can be hindered by the unavailability or shortage of resources.

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TABLES

Table 1: Socio-economic characteristics of tomato marketers (n=80)

Variable	Freq.	%	Mean	SD
Age				
<30	1	1.3		
31-40	33	41.2		
41-50	26	32.5	44.9	8.2
>50	20	25.0		
Sex				
Male	-	-		
Female	80	100		
Marital Status				
Married	79	98.8		
Single	-	-		
Widowed	1	1.3		
Educational Status				
No formal Education	10	12.5		
Primary Education	44	55.0		
Secondary Education	26	32.5		
Experience				
1-5	1	1.3		
6-10	5	6.3		
11-15	21	26.3	20.6	8.3
16-20	23	28.8		
>21	30	37.8		
Household size				
1-5	53	66.3	5.3	2.3
6-10	24	30.0		
>11	3	3.7		
Quantity (Baskets)				
≤50	43	53.8		
51-100	15	18.8	69.4	71.4
101-150	14	17.5		
151-200	7	8.8		
≥201	1	1.3		
Tomato Income (₦)				
≤50,000	43	54.0		
51,000-99,000	-	-		
100,000-149,000	17	21.4		
≥150,000	21	25.2		

Mean±SD Source: Field survey, 2015

Table 2: Tomato marketers post-harvest packaging, transporting and storage facilities

Variables	Frequency	Percentage
Storage structures		
Open shelf	80	100.0
Zero Energy Cooling Chamber	-	-
Refrigerators	-	-
Cold room	-	-

Source: Field survey, 2015

Table 3: Awareness of zero energy cooling chambers and improved post-harvest packaging facilities

Variables	AU	ANU	NA
zero energy cooling chambers			
Pot-in-Pot	-	-	80 (100)
Tin-in-pot	-	-	80 (100)
Brick-in-Brick	-	-	80 (100)

Source: Field survey, 2015 Note: figures in parantheses are percentages
AU- Aware and using ANU-Aware and not using NA- Not Aware

Table 4: Tomato marketers' evaluation of zero energy cooling chambers

Variables	**Effective (%)**	**Not Effective (%)**
Brick-in-brick		
Maintaining Fruit Firmness	80 (100)	
Maintaining Fruit Colour	80 (100)	
Shelf life Extension	80 (100)	
Quality Maintenance	80 (100)	
Reduces Diseases Incidence	77 (96.3)	3 (3.8)
Pot-in-Pot		
Maintaining Fruit Firmness	80 (100)	
Maintaining Fruit Colour	80 (100)	
Shelf life Extension	80 (100)	
Quality Maintenance	80 (100)	
Reduces Diseases Incidence	76 (95.0)	4 (5.0)
Tin-in-Pot		
Maintaining Fruit Firmness	75 (93.8)	5 (6.3)
Maintaining Fruit Colour	80 (100)	
Shelf life Extension	80 (100)	
Quality Maintenance	80 (100)	
Reduces Diseases Incidence	71 (88.8)	9 (11.3)