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STORAGE PERFORMANCE OF MORDERN ONION STORAGE STRUCTURE FACILITY MAKANI MODEL

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ABSTRACT

A comparative study of Makani Model a newly developed mordern onion storage structure and traditional onion storage system was conducted in Kura Local Government Area in Kano state Northern to determine their performances. Onions was stored for 120 days in Makani model which is a three tier mordern naturally ventilated storage structure and in house traditional method. The study was conducted from early July to October 2018. Hourly temperature and relative humidity of ambient and storage site were monitored and physiological weight, rotting percentage and percentage markeble onions on stored were recorded every ten days interval. The observation has shown that the temperature Makani model structure has similar pattern with the ambient environment. Total percentage of onions loss increases with storage period in both storage method lower values were observed in mordern onion storage structure (Makani Model) than the traditional storage method. On the 60th day after storage, the overall onion losses in Makani model structure and traditional storage were found to be 68.51% and 78.56% respectively

Keywords: Makani model, temperature, relative humidity , Physiological loss

1. INTRODUCTION

Onions (*Allium cepa* L.) are bulbous vegetables from the *Liliaceae* family. Onions are important vegetable crops grown mainly as food materials for domestic consumption and export in most part of the world particularly the varieties that are grown for bulbs. The global onion production figures have shown an upward trend of 51.6% with a production volume of 33 million tons in 2003 and 64 million tons in 2007 (Food and Agriculture Organization of the United Nations (FAO, 2010) and 74,250,809 tonnes from an area of 4,364,000 hectares (FAO, 2012) with Nigeria having up to 618,000 tons in the year 2007 (FAO, 2010). In terms of global weight of vegetables produced only tomatoes and cabbages exceed bulb onions in importance. *Allium* (Onion) is highly valued for their flavor, nutritional value and herbs because of their richness in vitamins (such as vitamins A and C), protein, minerals, and fiber. *Allium* (Onion) have interesting technological properties and beneficial health effects such as antioxidant, anticarcinogenic, antimicrobial, prebiotic, hypolipidemic, and antithrombotic properties that made them to have been revered not only for their culinary use, but also for their therapeutic properties (María, 2009) since 6th century as a medicine. No wonder, because of these

properties, Onion is grown in at least 175 countries (FAO) with China and India as the primary onion growing countries, followed by the USA, Egypt, Iran, Turkey, Pakistan, Brazil, the Russian Federation, and the Republic of Korea (FAO, 2012). Thus, the importance of Onions made it popular among poor people throughout the world including Nigeria for meals and herbal remedy of colds, coughs, bronchitis, anemia, cholera, influenza, disorders of urinary system and bleeding piles. However, the crop is one of the most important sources of income for smallholder farmers, women, young people and all actors engaged in the production-consumption chain.
Although onion is considered as a semi perishable crop, yet it is a delicate product to store due to its high water content. Depending on cultivar type and pre harvest as well as post-harvest treatments, onion bulbs can be stored at low temperature as 0-5°C or high temperature (25-30°C) maintaining the relative humidity in the range of 55%-70% (Chope, 2006 and Kukanoor, 2005). The overall storage losses under these storage conditions are high and generally increase with the increase in storage period. Hence, like every agricultural commodity, Onion requires to be stored properly to prevent it from qualitative and quantitative losses because of its process of development towards sprouting and decay by various disease causing organisms.

Onion (*Allium cepal L.*) is one of the major commercial vegetable crops grown in most parts of Nigeria in various states such as Borno, Sokoto, Kebbi, Jigawa, Zamfara, Kaduna and Kano because of its market profitable (Agricultural Extension Research and Liaison Services, 1985) with estimated revenue of N 2067 per bag in 2004 (Abduljabar, 2004). Kura Local Government area in one of such areas of Kano State where Onion in grown in large quantity mostly during the dry season with inadequate storage capacities that are mostly traditional and unscientific. As a result, during this period prices rule very low due to glut situation. Thereafter, the rise in prices is quite rapid and sometimes wide fluctuations occur leading to dissatisfaction amongst the producers as well as consumers. During this bulk production period, onion growers either sell their produce at low price in fear of high storage loss or store for a few days using traditional methods under ambient environment. In both cases, dealers have more control of onion price in favor of the growers because of poor or unavailability of storage facilities such as cold storage and where they are available they are beyond the reach of small holder farmers. These necessitate most of the farmers in Kura local government area to bring their onion directly to the market after harvest in order to avoid post-harvest loss. As posited by Mrema and Rolle, (2002) that about 20-40% of Onion are losses after Post-harvest due to inefficient storage techniques. This research intends to identify the causes of onions post-harvest losses incurred by the farmers, indigenous technologies used for Onion storage and desired to create natural ventilated onion storage structures facility using local materials in either farm, homes as well as at market places with the view to maintain the onion for as long as possible in an unchanged sound condition with longer shelf life, and allow them to transport and market it after removal from store without much loss.

2 MATERIALS AND METHOD

The investigation was carried out in Kura Local Government area, Kano state during July to end of October 2018. The area is located at located between 11° 46 ‘ 12.84’’ N and longitude 8°35’

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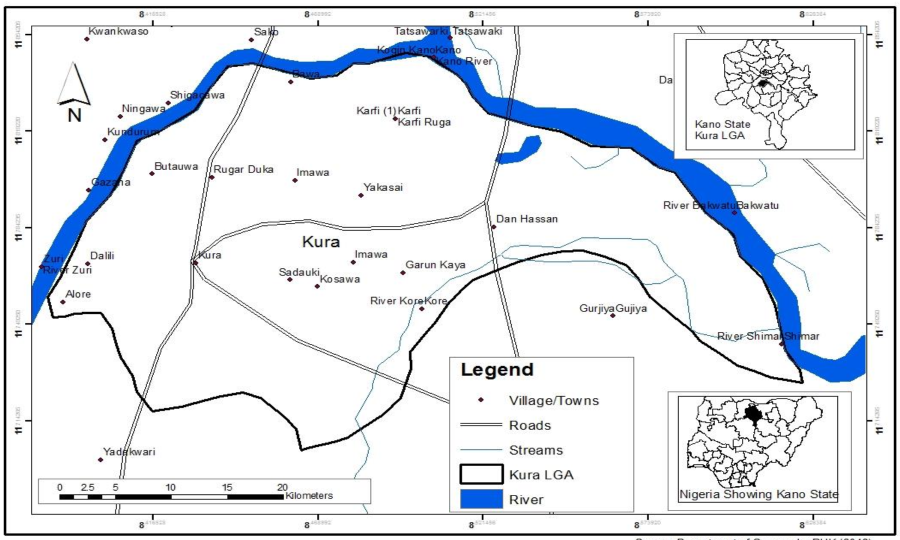
29.02'' E it is about 900kilometer from the edge of the Sahara desert and 1,140 kilometer away from the Atlantic ocean approximately.The area has four marked temperature regimes; Dry and Cool season (kaka), Dry and Hot season (bazara), Wet and Warm season (damina) Dry and warm season (rani) with mean annual temperature of 26ºc and 21ºc main monthly range of maximum temperature in December/January and over 35ºc which is hottest (April/May) wet season start in May and ends October (Olofin, 2008). While November to February is dry cool season with hamattan haze (figure 1).



Source: Department of Geography BUK (2012)

Fig 1: Map of Kura Local Government showing sample of the study area

Freshly harvested Onions were obtained from the study area. The onions used for the study were grown at farmers' fields. Both pre harvest and post harvest treatments, which have immense contribution on the effect of storage, were done according to onion farmers' practice. To fasten onion maturity the farm was trampled by human beings when 8% leafs have fallen and then left for about ten days. Then after, onions were harvested local hoe and piled in open place or partial shed.

The onion necks were manually trimmed using knife at height of 2-1 cm as practiced by onion farmers in the area. These onions were allowed to dry for 2 days so as to remove any traces of water on the surface of the onion. Sorting was carried out to remove onions having marked defects and only marketable onions were filled in to the storage.

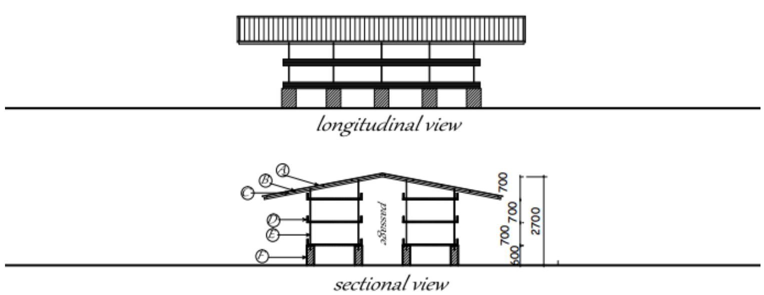
The storage methods used for this study were modern onion storage structure which was developed and is called makani model, the model in a naturally ventilated structure with a three tiers (MM) and storing in house using indigenous method that is traditional method often used by onion farmers in the study area.

The lower base of the Makani model onion storage structure was raised from the ground level by 1.5’ to 2.00’ and the foundation should be laid out according to soil type. Pillar height should be 18' (L) x 9' (W) x 2'(H) .The foundation makani model (MM) was constructed as raised platform above the ground level with down ventilation. This is because the experimental area is flooded during the raining season. Frame (skeleton) of structure was rest on these pillars and it is made up of iron angle material. Lower base was also made up of iron angle and stalk bed. Its breadth is 5’.

Side wall was made of stalk (Kara)/iron angle with the support and help of iron angles. Its height is 5’. Stalk (kara)/iron angles were arranged that onion should not come out of it and also proper air circulation was made which should be at 5’. Height of roof of modern onion storage structure was 2’ above onion stored. For roof was covered with 10 cm thick thatched grass material for heat resistant. Also according to model the structural design roof should have sufficient slope. To avoid droplet water and sunlight, side of the roof was sufficiently projected outside and also same from direction of rain (south –west).

The storage was provided with 3 compartments for storing the onions were constructed 25 cm and 125 cm respectively. Compartment width was 95 cm and the onion storage capacity of each compartment was estimated to be 30 bags of onion. passage was provided to fill and take out the onion. The capacity of makani model was 180 bags of onion but only 90bags of onion was filled for experiments (figure 2)

The traditional method which is mostly floor storage method and the same method was adopted for this study was farmer’s house. Its roof was covered with iron zinc and a slated wall plastered with cement at the interior side.



LEGEND			
SYMBOL	MEANING	SYMBOL	MEANING
A	Thatched (jinka)	D	Stalk(kara)
B	1'x2' square pipes pulins	E	Iron angle pillars
C	1-1/2'x2' square pipes rafters	F	Sand-crete base

Figure 2. Modern Naturally Ventilated Onion Storage Structure Facility (MAKANI Model)

90 bags of Onions were randomly selected and were kept on a floor in three sample locations namely Karfi,Gundutse and Danhassan ward of each storage at two host farmers. These sample onion were assess and weight visually data on marketabke onion, data on rotting onions, data on physiological loss and natural germination were recorded interval of ten days each. Onion was considered to have started rotting when there is any trace of decay around the neack area. The onion that is rotted and naturally germinated were sorted from the sample after recording so as to aviod diplicate counting (Kebede, L, and S. Aklilu 2007)

The relative humidity and temperature of both the storage and surrounding condition was monitored on every sixty minutes throughout the storage period using data loggers (Watch Dog data logger, Spectrum Technologies Inc.). The physiological weight loss was measured using sensitive balance (OHAUS Corporation, USA, with an accuracy of = 1 gm). Physiological responses of onion were determined during storage, initial sample weights were the base for all calculation.

The findings were subjected to t-test using SPSS (Statistical Package for Social Sciences) and graphs were plotted using Microsoft Excel.

3 Results and discussion

3.1 Temperature

The sixty minutes temperature of surrounding environment, Makani model and traditional storage system during the storage period have been observed and the daily mean values are plotted to compare in Figure 3

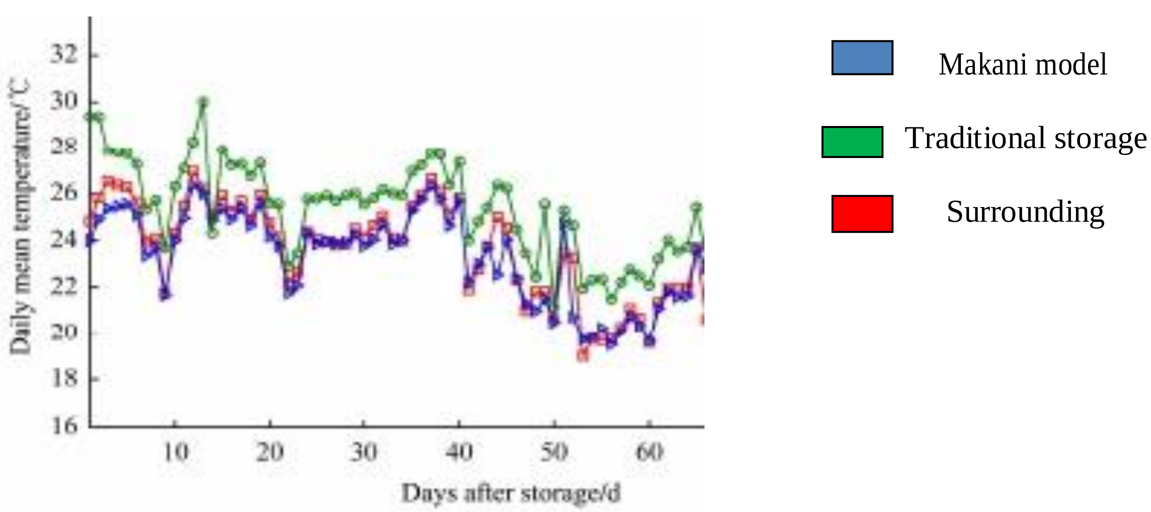


Figure 3 Differences of daily mean temperature of ambient and storage environment

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Makani model and traditional storage system, which showed significant ($P<0.05$) deferences throughout the storage period. The daily mean temperature of traditional storage method in most cases remained 28^0c to 29^0c higher than the surrounding and makani model(MM) temperature records. The recorded higher tempereature of traditional storage method is as a result of high thermal conductivity of iron zinc roofing. There is no significant difference ($P>0.05$) of temperature records between the surrounding condition and makani model (MM). The temperature values in the study area after storage were in the optimum temperature range (22^0c - 30^0c) for onion storage. At the end of July, the surrounding and makani model storage daily mean temperature record has decreased below 22^0c, which is lower than the optimum temperature for onion storage.

3.2 Relative humidity

Both modern onion storage structure makani model and traditional onion storage daily relative humidity finding during the storage period have been recorded and plotted in Figure 4.

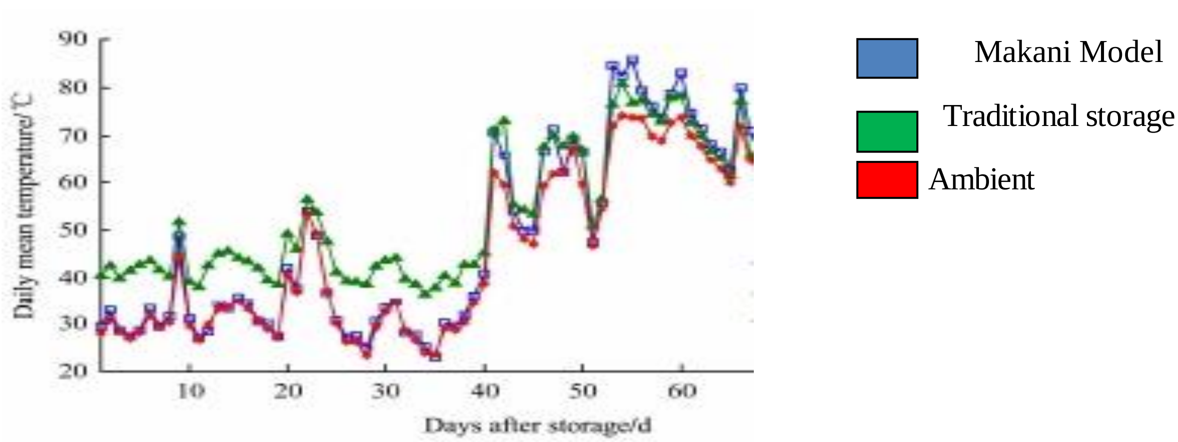

Figure 4 differences of daily mean relative humidity sourounding and storage environment throughout the storage period

The relative humidity of mordern storage stucture makani model (MM) during the storage period was around 40 % which was below the recommended optimum value (55% - 70 %) for onion storage. After the beginning of the raining season, the relative humidity of the surrounding as well as storage environment has increased and higher values than the desired limit recorded in surrounding and makani model (MM) for a few days.

3.3 Physiolocal loss in weight

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There is significant difference (P<0.05) between storage methods in relation to overall percentage of physiolocial loss in weight of stored onions within 90 days after storage. The physiological loss in weight of stored onions increases progressively with increase in days after storage in both methods (Figure 5).

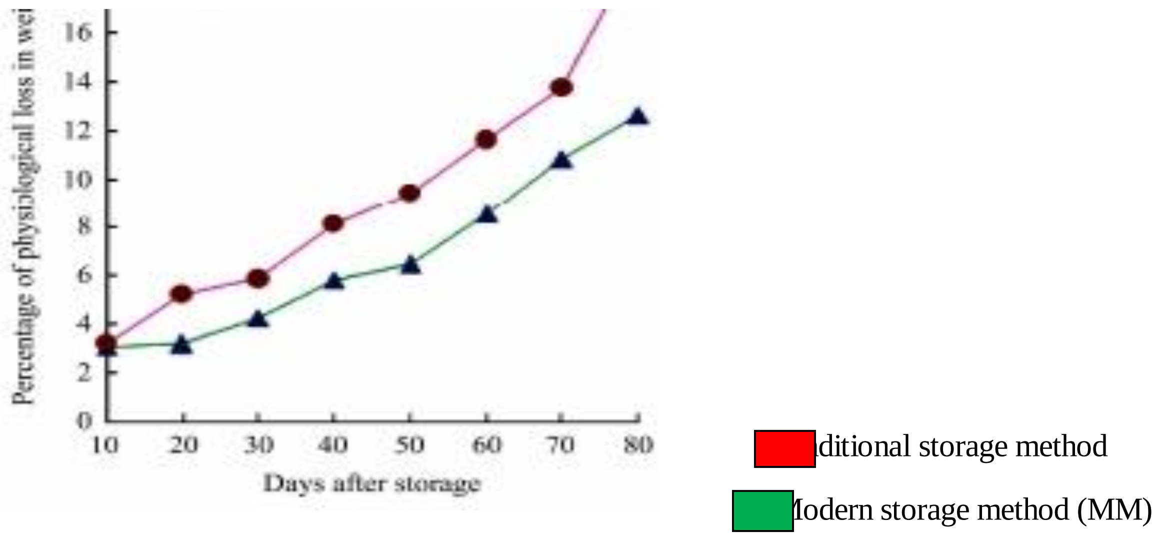

Figure 5 Physiological loss in weight of stored onions in both traditional storage method and mordern storage structure makani model (MM)

3.4 Percentage of onion rotting

Rotting was observed in the first one week of month of July 2018 in both storage methods which is ideal because the onion was fresh (Figure 6). It was not observed for the rest period until 7th August 2018 after storage.

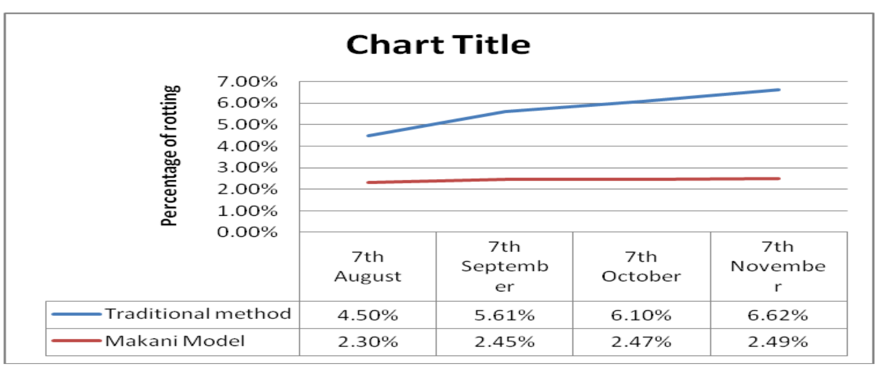

Figure 6 Percentage of rotting stored onions in both traditional storage method and mordern storage structure makani model (MM)

The percentage of rotting on 7th August 2018 was 2.30% and 4.50% for both modern onion storage structure makani model (MM) and traditional method respectively. It has indicated an increased with increase in storage period for both modern and traditional method of storage and the value observed on the 7th september 2018 was 2.45% and 5.61%, 7th October 2018 2.47% and 6.10% while on 7th November 2018 2.49% and 6.62% for respective storage method.

The percentage of rotting in traditional storage method was higher when compared to modern onion storage structure makani model. However the overall value of the findings show significant difference (P<0.05). Figure 6.

3.4 Percentage of marketable onions

Makani model which is the modern onion storage structure developed has higher percentage of marketable onions than traditional storage system throughout the experiment period and the overall values show significant difference (P<0.05). It has decreased with increase in storage period in both storage method (Figure 7).

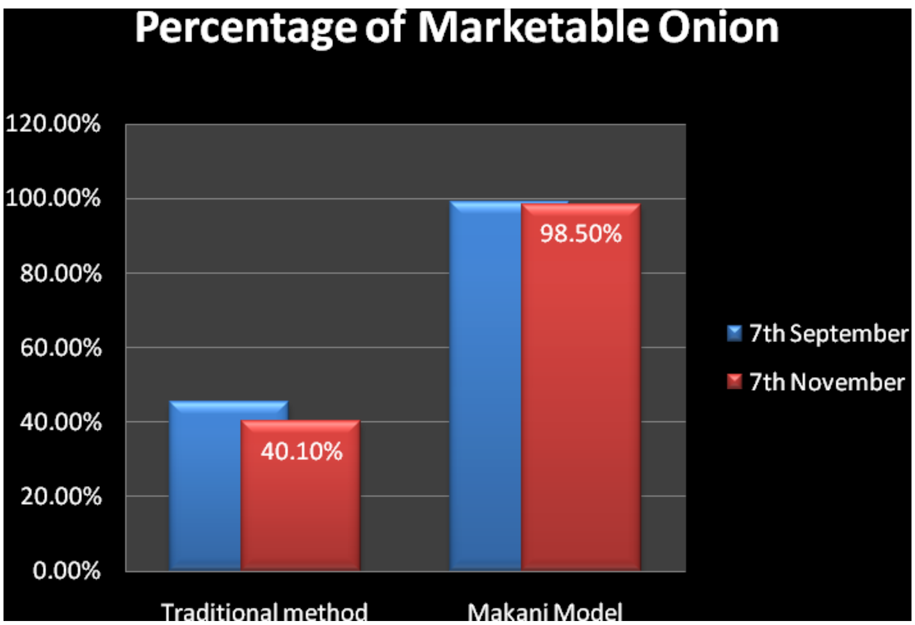

Figure 7 Percentage of Marketable Onions after storage

The maximum percentage of maketable onions on 7th September 2018 after the storage was 98.85% and 45.30% for modern onion storage sturcture makani model and traditional storage method respectively. The value has decrease to 98.50% and 40.10% on 7th November 2018 after storage for respective storage methods. This is due to lower relative humidity records than optimum for onion storage in traditional storage method.

4.CONCLUSION AND RECOMMENDATION

Based on this study traditional onion storage system has higher loss than newly developed makani model(MM) which is a modern onion storage stucture facility. This is due to lower relative humidity records than optimum for onion storage. This show that onion can be stored using makani model which is a natural ventilated storage structure up to five months or more with minimal and acceptable loss unitl favourable market is secured. The makani model can be built from locally available materials and skill with a little cost.

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