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Research Article

Effect of storage methods on some selected mineral and ascorbic acid content of red and white onion (*Allium cepa*)

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Abstract

The study investigated the influence of three different storage conditions in minimizing the postharvest losses of onions. The fresh onion walla-walla variety (red and white) were obtained from Modibbo Isah Farms, Bichi, Kano State, Nigeria. The onions were stored for eight weeks under three different storage conditions which include: Ambient temperature (30 ± 2 ºC), refrigeration storage (5-7 ºC) and control cupboard temperature storage (45-50 ºC) during which the samples were analysed weekly. During the storage period of onion bulbs, the temperature ranged between (29-32 ºC) while the relative humidity was between (70 – 95 % RH). The mineral (calcium, sodium and potassium) content was determined by Atomic Absorption Spectrophotometry while Ascorbic acid was determined by the 2, 6- dichlorophenol indophenol (DCPIP) titration. The result showed that some components of the stored onions decreased with an increase in the storage period and these include: ascorbic acid (9.62-3.87mg/100g) and sodium content (12.13-11.77mg/kg). While some parameters also showed an increase with an increase in the storage period and these include: potassium content (30.00-72.12mg/kg) and calcium content (55-105mg/kg).

Keywords: Ambient temperature, Refrigeration, Control cupboard, Red Onion and White Onion

Introduction

Onion (*Allium cepa L)* has been described as the dynamite of natural foods (Rune *et al.*, 2007). The outstanding characteristic of onion is its pungency, which is due to the volatile oil known as allyl-propyl disulfide. Onions contains vitamin B, vitamin C and traces of iron and calcium. Onions when compared with other fresh vegetables are relatively high in food energy, intermediate in protein content and rich in calcium and riboflavin (Rune *et al*., 2007).Onion cultivation in Nigeria is confined to the Semi-Arid, Northern Guinea and Savanna zones. The bulk of onion production is from the dry season cropping system particularly under irrigation in the Northern States (Amans, 2001). In this light, the greater part of onion production in Nigeria is undertaken in the north of the country specifically in Kaduna, Kano, Jigawa, Katsina, Sokoto, Plateau and Bauchi States. The natural features of these regions, especially the presence of flood prone plains and river basins and above all the development of very large irrigated lands, create a condition that greatly favours the development of this crop (Ojo *et al*., 2009). In comparison with other fresh vegetables, onions are relatively high in food value of antioxidant and phytochemicals. The crop is the second only to tomatoes in importance among the vegetables in Nigeria and fifth in the world market (Hussaini *et al*., 2000).

The objective of present study was to determine the most suitable storage method(s) and changes in the nutritional composition of two varieties of onions during storage and also this work is designed to prolong the shelf life of onion, that are stored under three different storage conditions which include (refrigeration at 5-7 ºC, ambient temperature at 30 ± 2 ºC and controlled cupboard temperatures at 45 ºC-50 ºC). Furthermore the work has also evaluated the ascorbic acid content and some selected mineral content of Red and White Onions.

Materials and methods

Source of materials

The fresh sample of red and white (Walla-walla) onion varieties were obtained from Modibbo Isa farm, Kano North, Bichi Local Government areas, at the longitude of 12º 14’ 8” North and latitude of 8 º 14’ 21” East. The onions was harvested in the early morning and collected in traditional basket, the samples were cured (air dried) for two weeks immediately after harvesting, cultivation of red and white onions was the same. After harvesting the onion was taken to the home for curing under a condition of temperature and relative humidity (25 ºC and 70%) respectively,and then transported to Kano State University of Science and Technology Food analysis laboratory and Bayero University, Kano for analysis. All reagents used were of analytical grades and were purchased from a chemical store in Kano State, Nigeria.

Methods

The Cured onions were stored for two months January and February during which experiment took place. Each sample was replicated three times *i.e.* 2 by 3 Factorial, which include: Ambient temperature of 30 ± 2 ºC, refrigeration at 5 - 7 ºC and Controlled Cupboard temperature at 45 - 50 ºC. The prevailing relative humidity during the storage period ranged between 70 and 95 %.

Ambient temperature

In ambient storage, the cured onions were stored in two different storage cupboards at 30 ± 2 ºC. One cupboard was made to contain 45 bulbs of red onions, and other cupboard

45 bulbs of white onions. The cupboards were made from plywood material and all the sides were covered with wire gauze, the dimensions of which were 2 m length, 1.5 m height and 1 m breadth.

Refrigeration storage

In refrigeration storage, the cured onions were stored in two different fridges at 5 - 7 ºC. One fridge was made to store 45 bulbs of red onions and the other fridge 45 bulbs of white onions at the same storage temperature.

Controlled temperature cupboard storage

In the controlled temperature cupboards, the cured onions were stored at 45-50 ºC. One cupboard contained 45 bulbs of red onions and the other 45 bulbs of white onions. The cupboards were constructed with plywood materials having some holes by the sides to allow gaseous exchange within the produce. The temperature of 45 - 50^{o}C was maintained with electric filaments or bulbs and the temperatures were measured by thermometers. The dimension of each of the two cupboard were 2 m length, 1.5 m height and 1 m breadth.

Determination of mineral content of onion sample

According to method outlined by AOAC, (1990) mineral (calcium, sodium and potassium) content was determined by Atomic Absorption Spectrophotometry (Model 6800 series Shimazo Corp). The mineral content of the sample was determined by weighing (5g) of sample and then ashing it .The ash obtained from the muffle furnace (product of the ash content determination) was dissolved in 10 ml of 10% HCL. The mixture was heated on a steam bath to effect complete dissolution and the dissolved ash was filtered using Whatman filter into a 100 ml volumetric flask and made up to volume with distilled water. The mineral content was determined using an Atomic Absorption Spectrophotometer (Alpha 4-Chem. Tech Analytical, USA).

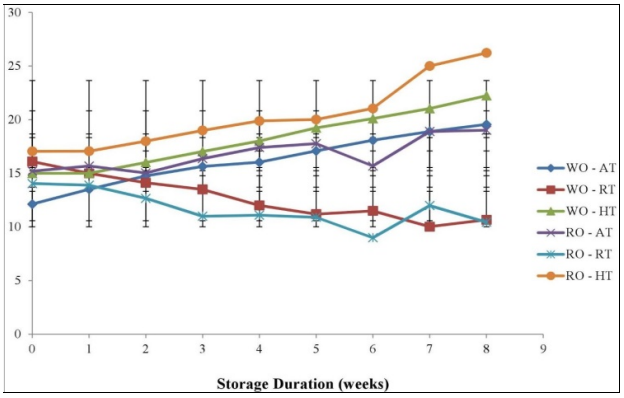
Determination of Ascorbic acid content of stored onions

5g of the sample was used to determine the Ascorbic acid content by the 2,6- dichlorophenol indophenol (DCPIP) titration based on the method described by AOAC (1990).

Result and Discussion

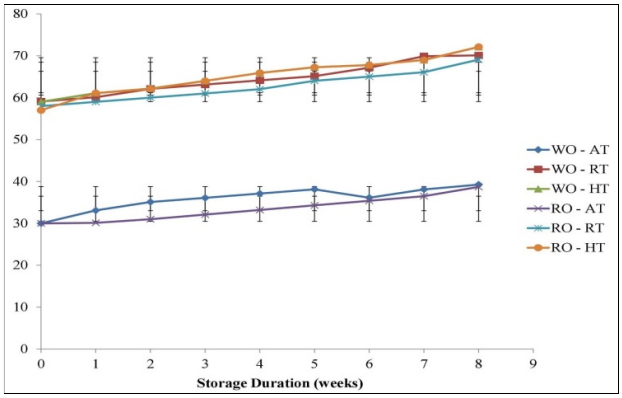
Selected Mineral Content of Onions Subjected To Three Storage Conditions As Influenced by Storage Duration

Figure 1: shows the sodium content of onions stored subjected to three different storage conditions. The onions showed that samples WO-AT, WO-HT, RO-AT and RO-HT exhibited an increase in the sodium content with respect to the final values which is higher than the fresh values at the end of storage period although oscillating changes in sodium content was experienced during the storage period. In the case of WO-RT and RO-RT exhibited a decrease in the sodium content, the final sodium content at the end of the storage period was lower than the fresh values. For example in the case of RO-AT samples, the sodium content increased up to the 5th week of storage (17.77%) and thereafter decreases up to the 6th week (15.68%) before it started to increase again up to the 8th week of storage (19.02%).The decrease in sodium content may be as a result of the temperature of the environment during the storage period. The values obtained for sodium content of fresh harvested onions were similar to the value reported by Rodrigues *et al*. (2008) which observed an increase in the sodium content of onions under ambient storage and a decrease under refrigeration storage while Jurgiel-Maleck *et al.* (2014) observed an increase for all the storage condition.



WO – AT = White onion stored at Ambient Temperature (30 ± 2 ºC)
WO – RT = White onion stored at Refrigeration Temperature (5 -7 ºC)
WO – HT = White onion stored at High Temperature (45 -50 ºC)
RO – AT = Red onion stored at Ambient Temperature (30 ± 2 ºC)
RO – RT = Red onion stored at Refrigeration Temperature (5 -7 ºC)
RO – HT = Red onion stored at High Temperature (45 -50 ºC)

Fig. 1. Changes in sodium content of onions (mg/kg) with storage duration in weeks

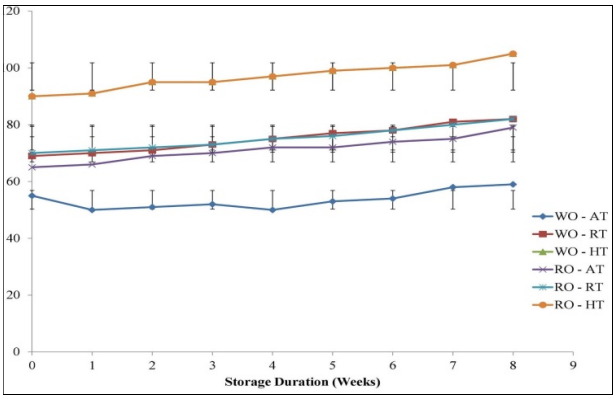


WO – AT = White onion stored at Ambient Temperature (30 ± 2 ºC)
WO – RT = White onion stored at Refrigeration Temperature (5 -7 ºC)
WO – HT = White onion stored at High Temperature (45 -50 ºC)
RO – AT = Red onion stored at Ambient Temperature (30 ± 2 ºC)
RO – RT = Red onion stored at Refrigeration Temperature (5 -7 ºC)
RO – HT = Red onion stored at High Temperature (45 -50 ºC)

Fig. 2. Changes in potassium content of onions (mg/kg) with storage duration in weeks

Fig. 2 shows the potassium content of stored onions subjected to three different storage conditions. The stored onions exhibited an increase in the potassium content across the storage period in both the storage conditions. The WO-HT, WO-RT, RO-HT and RO-RT samples exhibited high increase in potassium content when compared with WO-AT and RO-AT samples which exhibited slightly increase in potassium content at the end of storage period. This might be attributed to the temperature of environment during the storage period. Both the samples showed an increase in potassium content across the storage period. The increase of potassium content in ambient and control cupboard storage may be due to the effect of storage temperature. The increase in the potassium content of stored onions under ambient

storage and refrigeration storage was observed across the storage period which is similar to the observation of Asanja *et al*. (2015).

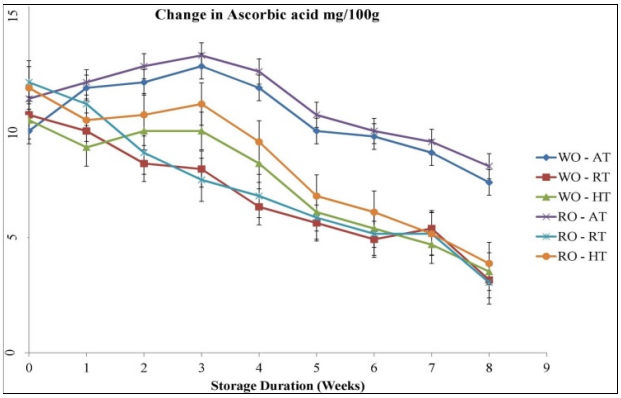


WO – AT = White onion stored at Ambient Temperature (30 ± 2 ºC)
WO – RT = White onion stored at Refrigeration Temperature (5 -7 ºC)
WO – HT = White onion stored at High Temperature (45 -50 ºC)
RO – AT = Red onion stored at Ambient Temperature (30 ± 2 ºC)
RO – RT = Red onion stored at Refrigeration Temperature (5 -7 ºC)
RO – HT = Red onion stored at High Temperature (45 -50 ºC)

Figure 3: Change in calcium content of onions (mg/kg) with storage condition in weeks

Fig. 3 shows the calcium content of stored onions subjected to three different storage conditions. The onions were generally observed an increase in calcium content across the storage period in all the samples with respect to the final values at the end of storage period. But in the case of WO-AT samples, exhibited an oscillating changes during the storage period, the calcium content decrease in 1st week of storage up to (50 mg/kg) and thereafter got an increase in 2nd and 3rd week of storage and then got decreased on the 4th week of storage before it started to increase again up to the 8th week of storage (59 mg/kg). Both the samples increase in calcium content across the storage period. The increase in calcium content in ambient temperature storage and high temperature storage may be due to the effect of storage temperature during the storage period while the increase in refrigerated onion may be due to the increase in moisture content during the storage period. The results obtained in this study stored is similar to the report of Yahaya *et al.* (2010) which shows an increase in the calcium content of onions under refrigeration storage condition while Anju *et al.* (2010) contrarily observed a decrease in calcium content of onion under refrigeration and ambient storage. The analysis of mineral composition of the *Allium cepa* bulb extracts revealed the presence of sodium, potassium and calcium. These mineral elements are considered critical for the normal functioning of the human body.

Fig. 4 shows the value of ascorbic acid content of stored onions in three different storage conditions. All the onions exhibited a decrease in ascorbic acid content when compared with the values of cured samples. However, during the course of storage, the onions showed an oscillating trend of changes in the ascorbic acid values. The decrease in ascorbic acid across the storage period may be due to the effect of water activity and temperature of storage. Both the samples exhibited a decrease in ascorbic acid content across the storage period. For example, in the case of RO-RT samples, the ascorbic acid content decreased up to 6th week (5.16 mg/100g), got constant up to the 7th week (5.16 mg/100g) and then started to decrease up to the 8th week (3.03 mg/100g). Hellmann and Rembialowska (2006) reported that there is a decrease in the ascorbic acid content of onions under ambient storage while Biezanowska-kopec *et al.* (2011) observed an increase in the ascorbic acid content of onions under refrigeration storage.



WO – AT = White onion stored at Ambient Temperature (30 ± 2 ºC)
WO – RT = White onion stored at Refrigeration Temperature (5 -7 ºC)
WO – HT = White onion stored at High Temperature (45 -50 ºC)
RO – AT = Red onion stored at Ambient Temperature (30 ± 2 ºC)
RO – RT = Red onion stored at Refrigeration Temperature (5 -7 ºC)
RO – HT = Red onion stored at High Temperature (45 -50 ºC)

Fig. 4. changes in Ascorbic acid content of onions (mg/100g) with storage duration in weeks

Presence of ascorbic acid in the bulb extract of *Allium cepa* may explain its use in treating itching, skin infections, eczema and psoriasis. According to a previous study (Okwu and Okwsu, 2004), onions can be used in the treatment of prostate cancer and common cold and also act as antioxidant for dietary material.

Conclusion

Different effects of storage conditions occurred in cured (red and white) onions varieties during storage period, which caused reduction in nutritional quality. Results revealed that quality of stored onions correlated with the storage temperatures, higher change in onion during storage were in refrigerated onions (5 -7 ºC). On the other hand, ambient temperature (30 ±2 ºC) and control cupboard temperature (45 – 50 ºC) was found with less deleterious effects on the nutritional quality of stored onion during the storage period. Lastly it could be concluded that onion could be stored at (30 ±2 ºC) and (45 – 50 ºC) for two months without adverse effect on nutritional quality.

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