African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 4, 2024 (pp. 1-9)
www.abjournals.org

COMPARISON OF TWO STORAGE TECHNIQUES ON THE NUTRITIONAL COMPOSITION OF ONION BULBS

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Cite this article:

Lawal, H. M., Salau, I. A. (2024), Comparison of Two Storage Techniques on the Nutritional Composition of Onion Bulbs. African Journal of Environment and Natural Science Research 7(4), 1-9. DOI: 10.52589/AJENSR-FUM4L6GP

Manuscript History

Received: 14 Jul 2024

Accepted: 11 Sep 2024

Published: 26 Sep 2024

ABSTRACT: *Onion (Allium cepa L.) has been valued as a food and medicinal plant since ancient times. It is widely cultivated, second only to tomato, and is a vegetable bulb crop known to most cultures and consumed worldwide. This study investigated the effects of two (2) storage techniques on the nutritional composition of onion bulbs. During storage periods, the onion bulbs deteriorate due to rotting, sprouting, black mould and physiological loss in weight, which have been a major problem for onion growers. The result of onion bulb after storage on a wooden platform shows the highest content of moisture (33.30% ± 1.24) followed by crude protein (23.62% ± 0.53), crude fibre (15%± 0.67), ash content (10.60% ± 0.63) and the lowest was obtained in the crude lipid (10% ± 0.68). The result of the proximate analysis indicated that the moisture content significantly differed between the fresh bulbs (35%) and the stored samples with a cemented floor having the lowest moisture content (20%). The loss of moisture from the bulbs during storage could be because the bulbs were stored in a dry and aerated environment that could subject the bulbs to loss of water. The losses in the onion bulbs may be reduced to a certain level through opposite storage methods. From the research, it could be concluded that a wooden platform on the floor is the best method of storage for onion bulbs.*

KEYWORDS: Onion, Nutritional composition, Storage techniques and Rotten.

Article DOI: 10.52589/AJENSR-FUM4L6GP
DOI URL: https://doi.org/10.52589/AJENSR-FUM4L6GP

INTRODUCTION

Onion (*Allium cepa L.*) has been valued as a food and medicinal plant since ancient times. It is widely cultivated, second only to tomato, and is a vegetable bulb crop known to most cultures and consumed worldwide (FAO, 2012). The last half century has seen exponential growth in the world production of onion bulbs at a rate of approximately 3.6% per year, from 15 million tonnes in 1960 to 82.9 million tonnes from 4.2 million hectares in 2012 (FAO 2014). According to (Brewster, 2008) onions are biennial, herbaceous plants with tubular leaves and a swollen pithy stem base, which function as a drought-resisting organ. Most onion varieties are grown from seeds sown either in boxes or nursery beds and transplanting the young seedlings into the field at two true leaf stages. The crop can be harvested immature or fully bulb; stored for a long period or cooked immediately after harvest. Onions are relatively high in food value, intermediate in protein content and rich in calcium and riboflavin (Brewster, 2008) He added that mature onion contains approximately 86% water, 1.4% protein, 0.2% fat, 11.0% carbohydrate, 0.8% fibre, and 0.6% ash. The odour is mainly due to organic sulphur compounds, mostly by n-propyl disulphate that is produced only when the tissues are cut or injured by enzyme action on water-soluble amino acids. Ayodele (2008) reported that in Nigeria, commercial onion production is predominantly in the North, with bulb yield of up to 25t/ha. It was estimated that a land area of between 0.1 and 0.2 million hectares is cropped annually (Ayodele, 2008). The crop is cultivated in two marked seasons: rainy season (April - September) and dry season (September through December - April) but the bulk of this was cultivated in the dry season because of the high incidence of pests and diseases prevalent under the hot humid condition of the rainy season restricts the major onion production to the dry season (under irrigation) in the Sudan Savanna ecological zone, a semi-arid belt in West Africa (Bruce et al. 1997). Also, it was reported on the induction of biennial reproduction in short-day onions in eastern Nigeria. Similarly, Babatola and Lawal (2000) have recorded up to 16.7 tons in western Nigeria. The CBN (1994) reported that Sokoto state is the highest onion-producing state in the country with about 615,000 hectares under onion cultivation and a production figure of about 41,000 tons per annum.

However, the bulbs are easily destroyed in storage. Since it is not grown all year round, it is necessary to find the best storage techniques. It is therefore important to store onion bulbs successfully with minimal deterioration. A good storage technique reduces onion losses due to storage spoilage and maximises returns on investment as well as safeguarding public health. Information on the effective, efficient and environmentally sustainable storage techniques in Nigeria could be the basis for the reduction of onion losses and wastage in Nigeria. The aim of the study was to assess the effect of two storage techniques on the nutritional composition of onion bulbs.

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MATERIALS AND METHODS

Collection of samples

Freshly harvested onion bulbs of cultivars widely grown in Northern Nigeria were collected using purposive sampling techniques. The onions were cured for two weeks under the shade. Cured onions were stored for 4 months using two (2) storage techniques

Storage Techniques

The purchased onion bulbs were stored according to the following traditional method;

i. Heaping on a wooden platform raised on the floor

ii. Heaping on a cemented floor of a laboratory.

Data on rotting and physiological weight loss were recorded at monthly intervals for 4 months. The incidences of rotting, nutritional content and physiological weight loss were computed following a method reported by Shehu and Suberu (2015) with modifications: Incidence of rotting/sprouting/weight loss = Proportion of rotten/sprouted/ dehydrated onions divided by total onions stored in each treatment multiplied by 100.

Proximate Analysis

To assess the food quality loss due to storage, a proximate analysis of onion bulbs will be conducted before and after storage. All experiments carried out will be replicated three (3) times and the means determined. The following experiments were conducted in accordance with the standard method.

Determination of Moisture Content

To assess the water content in a fresh onion bulb, two (2g) of the onion bulb were placed in pre-weighed crucibles (wo). The crucible and onion were weighed (w_1) and placed into a hot air-drying oven at 105^0c for 2 hours. The crucible with the onion was then placed in a desiccator and allowed to cool. After cooling the sample was weighed (w_2).

Where; w_0 = empty dish

W_1 = sample wet

W_2 = sample dry

The percentage moisture content was determined with the formula below;

% moisture content = $\frac{w1-w2}{w1-wo}$ x 100

Determination of Ash Content

To assess the ash content in fresh onion bulbs, two (2g) of the onion bulbs were placed in pre-weighed crucibles (wo). The crucible and onion were weighed again (w_1) and placed into a muffle furnace at 500 - 600^0c for 3 hours. The crucible with the onion piece was then placed in a desiccator and allowed to cool. After cooling, the sample was weighed (w_2).

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The ash content was determined using the ignition method, percentage ash content was determined with the formula below;

% ash content = $\frac{w2-w0}{w1-w0}$ x 100

Determination of Crude Lipid

To assess the lipid content in fresh onion, two (2g) of the onion bulb was weighed two hundred and fifty (250ml) extraction flask was dried in an oven at 105-110^{0}c and was allowed to cool in a desiccator, cooling the extraction flask was weighed empty (w_2). Two (2g) of the onion bulbs were weighed and transferred into a labelled porous thimble (w_1). The mouth of the porous thimble was covered with a clean cotton wool (w_0) 200ml of petroleum ether was added into the hot air oven-dried extraction flask. The covered porous thimble was placed in a condenser and the apparatus was assembled. Extraction continues for 5-6 hours. The porous thimble was removed and the petroleum ether was collected and the extraction flasks were removed when it is almost free of petroleum ether. The extraction flask containing the oil was taken to a hot air-drying oven at 105^{0}c for 1 hour. The flask was allowed to cool in a desiccator, and after cooling, the sample was weighed.

The percentage crude lipid content was determined with the formula;

% crude lipid content = $\frac{w2-w1}{2}$ x 100

Determination of Crude protein

To assess the crude protein content in a fresh onion bulb, two (2g) of the onion bulb were weighed; the onion was weighed and immersed in 20cm^3 of distilled water in a Micro Kjeldahl flask. The sample was shaken and allowed to stand for 30 minutes. Half of a catalyst mixture was added to speed up the digestion followed by the addition of 20cm^3 contraction of H_2SO_4. A digestion block was used to heat the sample in a flask at 100^{0}c until the digest became clear. After the digestion was completed, the content was allowed to cool and was diluted to 50cm^3 with distilled water and filtered through Whatman no.1 filter paper in a 100cm^3 standard flask.

Ten (10cm^3) of the digest was taken into the distillation unit. The conical flask containing 20cm^3 to boric acid indicator was placed under the condenser outlet; 20cm^3 of 40% NaOH was added to the content in the Kjeldahl distillation flask by opening the funnel stop cock. At the end of the distillation, the distillate was received into a receiving flask containing 20cm^3 of boric acid indicator solution. After distillation, the nitrogen content in the distillation was determined by filtrating with 0.01m H_2SO_4 and an endpoint was obtained when the colour of the distillate changed from green to pink.

Crude protein is a measure of nitrogen in the sample which can be calculated by multiplying the total nitrogen content by a constant 6.25. This is based on the assumption that protein contains about 16%N.

The percentage crude protein content was determined with the formula below;

$$\frac{tvx0.01x0.014x50x100}{2x10}$$

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Where TV= Titre value

Determination of crude fibre

To assess the fibre content in fresh onion, two (2g) of onion bulbs were weighed The onion was weighed and placed in a conical flask W_1 containing 100cm^3 of distilled water and 20cm^3. 30% of concentration of H_2SO_4 was added and boiled gently for 30mins. The content was filtered through Whatman no.1 filter paper. The residue of the sample scraped back into the flask. (100cm) of distilled water with 20cm of 10% NaOH was added to the residue and was allowed to boil for 30 minutes. The content was filtered and the remaining residue was washed thoroughly with distilled water. The precipitate was scraped in a crucible and placed in a hot air drying oven at 100^{0}c to dry overnight. The crucible was later removed and allowed to cool in desiccators. After cooling, the crucible and dried sample were weighed (w_1) and ashes at 550^{0}c for 90 minutes in a muffle furnace, the crucible with onion piece was placed in desiccators and allowed to cool. After cooling, the sample was weighed (w_2). Rosie (2007)

The percentage crude fibre content was determined with the formula below;

% fibre content = $\frac{w1-w2}{2}$ x 100

Weight loss in onion

The weight of the onion bulbs was measured and recorded after an interval of one month, up to four months of storage. The incidence was expressed as a percentage of bulbs affected out of 100 bulbs.

Statistical Analysis

Data collected from the experiment was analysed using descriptive statistics and values were expressed as mean and standard deviation (S.D).

RESULTS

The result of the proximate analysis of onion bulbs (moisture, crude, protein crude fibre, lipid ash) stored under different conditions indicates significant differences in moisture, protein and lipid contents. The result of onion bulb before storage shows the highest content of moisture (35% ± 1) followed by crude fibre (30% ± 0.67), crude protein (21.43% ± 0.82), crude lipid (20± 0.70) and the lowest was obtained in the ash content (12.5% ± 0.46) which is present in table 1.

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Table 1: Proximate content of onion Bulb samples before storage.

S/N.	Component	Mean ± SD
1	Moisture	35.0 ± 1.23
2	Crude Protein	21.43 ±0.82
3	Crude Lipid	20.0 ±0.70
4	Ash	12.5 ± 0.46
5	Crude Fibre	30.0 ± 0.67

Table 2 shows the result of onion bulbs after storage on a wooden platform, the highest content of moisture (33.30% ± 1.24) was followed by crude protein (23.62%± 0.53), crude fibre had (15%± 0.67), ash content (10.60% ± 0.63) and the lowest was obtained in the crude lipid (10% ± 0.68) which is present in table 2.

Similarly, the result of onion bulbs after storage on a cemented floor shows the highest content of crude protein (28% ± 0.96) followed by moisture content (20%± 0.70), Ash content (10.15% ± 0.4) and the lowest was obtained in the crude lipid and crude fibre (10 ± 0.60, 10% ± 1) which is present in table 2.

Table 2: Proximate content of onion Bulb samples after storage in two different methods

S/N.	Component	Wooden platform	Cemented floor
1	Moisture	33.30 ± 1.24	20±0.70
2	Crude Protein	23.62±0.53	28±0.96
3	Crude Lipid	10 ±0.68	10±0.60
4	Ash	10.60 ± 0.63	10.15 ±0.4
5	Crude Fibre	15± 0.67	10± 1

In this method of storage, it was observed that there were three onion bulbs rotten in the wooded platform in 3rd month and 5 onions in 4th month, while on the cemented floor, rotten started since the first month of storage with 1, second month 4, third month 9 and 11 rotten in the 4th month, and the incidence was express as onion affected out of 100 bulbs. The result is presented in Table 3.

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Table 3: Number Of the Onion Bulb That Are Deteriorated during Storage.

Months	Wooden platform	Cemented floor
Month 1	0	1
Month 2	0	4
Month 3	3	9
Month 4	5	11

Similarly, the weight loss of onion bulbs percentage influenced by storage methods was presented in Table 4. The cemented floor had the highest weight loss in the fourth month with 7 onions and there is no weight loss in the first month for both two storage methods. The incidence was expressed as onion affected out of 100 bulbs.

Table 4: Weight Loss in Stored Onion as influenced by Storage Methods

Months	Wooden platform	Cemented floor
Month 1	1	0
Month 2	2	4
Month 3	3	4
Month 4	5	7

DISCUSSION

The result of the proximate analysis indicated that the moisture content significantly differed between the fresh bulbs (35%) and the stored samples with a cemented floor having the lowest moisture content (20%). The loss of moisture from the bulbs during storage could be because the bulbs were stored in a dry and aerated environment that could subject the bulbs to loss of water. This agrees with the findings of Tripathi and Lawande (2019) who reported water loss as a significant factor affecting onion storage. Similarly, Msika and Jackson (1997) reported weight losses between 2 and 5% per month in warm ambient storage conditions. This could equally be attributed to loss of content. Msika and Jackson (1997) also observed a relatively low initial rate of water loss through the skin and a low level of respiration of the dormant bulbs.

Crude protein (CP) and lipid content were observed to have significantly increased during storage although the crude protein content was lower than what was reported (8.95g/ 100g) by USDA (2008), the increase could be because of the decrease in the moisture content, the protein

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and lipids have accumulated and thereby resulted in increased in the concentrations during storage. This agrees with the fact that when the proximate water component decreased, the concentrations of another component increased. The stored onion sample showed appreciable ash and fibre contents with the ash content ranging between 12.5 to 10.60g in the stored onion while the fibre content ranges between 30 to 15g, in the stored onion. This suggests that the use of stored onions is very important.

Shehu and Muhammad (2011) reported that the increase in weight loss towards the end of the storage period could be due to the decrease in temperature or due to the loss of dormancy in the bulbs. Many workers indicated that if the duration of storage is extended into the winter season and the temperature drops to intermediate levels, sprouting is rapidly encouraged.

CONCLUSION

The study concludes that storing onion bulbs on a raised wooden platform is an effective method for preserving their nutritional composition during storage. The results indicate that this method minimises the loss of key compounds, compared to other storage methods. The elevation provided by the wooden platform allows for better air circulation, reducing moisture accumulation and preventing rot and fungal infections that can degrade the nutritional quality of the onions. By maintaining the integrity of the onion bulbs' nutritional content, this storage method proves to be a practical and efficient solution for farmers and distributors aiming to extend the shelf life and market value of their produce. The study recommends the adoption of raised wooden platforms as a preferred storage practice for onion bulbs, especially in regions where long-term storage is necessary.

Future research should explore the impact of varying environmental conditions, such as temperature and humidity, on the effectiveness of this storage method as well as its applicability to other types of produce.

ACKNOWLEDGEMENT

We wish to express our sincere gratitude to Shehu Shagari College of Education, Sokoto and Tertiary Education Trust Fund (TETFUND, Abuja) for sponsorship of this research.

CONFLICT OF INTEREST

The authors have declared that no competing interests exist.

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