



Comparative Study on Flavor, Texture, and Quality Preservation in Onion Bulbs (*Allium cepa* L.) under Two Storage Methods

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ABSTRACT

Onion bulbs (*Allium cepa* L.), a staple in global cuisine, are valued for their distinctive flavor, texture, and nutritional benefits. However, maintaining their quality during storage presents challenges, particularly under conventional methods used in regions like northern Nigeria. This study compares the effects of two storage techniques wooden platforms and cemented floors on key quality parameters of onion bulbs, including storage loss, dry matter (DM) content, total soluble solids (TSS), firmness, pungency, and yield. A systematic evaluation was conducted, measuring parameters such as DM content, TSS (via hand refract meter), firmness (subjective scale), pungency (sensory evaluation), and storage loss over six months. Statistical analyses determined significant variations between storage methods. Wooden platforms demonstrated superior quality preservation, with lower storage loss (21.8%), higher firmness (8.00), greater DM content (17.7%), elevated TSS (17.3 °Brix), and enhanced pungency (3.00). Conversely, cemented floors yielded a higher bulb dry yield (2.27 t/ha), highlighting its productivity potential. These findings emphasize the critical role of storage techniques in preserving onion quality and ensuring market value. Wooden platforms are recommended for their ability to retain quality attributes crucial for consumer satisfaction and extended shelf life, while cemented floors are better suited for maximizing yield. This research provides practical insights for optimizing onion storage strategies to meet diverse agricultural and market demands.

INTRODUCTION

Onion bulbs (*Allium cepa* L.) are essential in global cuisine, prized for their distinctive flavors and significant nutritional contributions. Rich in vitamins, minerals, and beneficial phytochemicals, onions offer numerous health benefits alongside their culinary appeal. However, maintaining the quality of onion bulbs during storage poses challenges, as improper handling and environmental conditions can lead to degradation in flavor, texture, and nutritional content, impacting both consumer satisfaction and market value.

The product is 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 acid. Ayodele (2008) reported that in Nigeria, commercial onion production is predominantly in the North, with bulb yield of up to 25t/ha.

The preservation of flavor and texture is especially important, as these sensory qualities are critical for the acceptance of onions in a wide range of culinary applications. The common practices of storing onions in the north are heaping the bulbs on the ground in straw huts built specifically for the purpose, storage in mud huts, storage on wooden planks raised off the floor of straw huts and bagging in jute sacks. These practices are conventional and have remained basically the same over the century. While in storage, a large proportion of the onion bulbs are lost and wasted in the form of rotting and sprouting especially under ambient, during the rainy season (Shehu and Muhammad, 2011; Salau *et al.*, 2017). It can also alter the sensory qualities of sensitive vegetables like onions. Ambient storage, though it may retain some desired qualities, can lead to faster spoilage if not carefully managed.

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This study addresses the need to understand how various storage techniques influence the flavor, texture, and overall quality of onion bulbs over time. The findings will not only contribute to the knowledge of optimal storage practices but will also provide actionable insights for consumers and producers, aiming to enhance the culinary quality and nutritional value of this essential vegetable.

MATERIALS AND METHODS

Collection of samples

Freshly harvested onion bulbs of cultivar 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 6 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.

Fresh Weight Measurement and Split Bulbs Count

After curing, the total fresh weight of bulbs was recorded for each plot. Split bulbs were visually counted per plot, expressed as a percentage of the total bulb count, following the procedure outlined by Walle *et al.* (2018).

Dry Matter Content

The dry matter (DM) content of bulbs was calculated on a dry weight basis using the standard method described by Walle *et al.* (2018).

Total Soluble Solids (TSS)

The TSS content of bulbs was measured using a hand refractometer (ATAGO, Master53M, Japan) with a range of 0-30 °Brix.

Bulb Shape Index (SI)

The bulb shape index, a measure of bulb shape, was calculated as the ratio of polar diameter (distance between the crown and root attachment) to equatorial diameter (maximum bulb width perpendicular to the polar diameter) following Dowker and Fennell (1974):

- SI < 1: Flat bulb.
- SI = 1: Globular bulb.
- SI > 1: Torpedo shaped bulb.

Bulb Firmness

Firmness was assessed subjectively by squeezing bulbs with the hand, following Larsen and Cramer (2004). Bulbs were rated on a 1-9 scale, with 1 being the softest and 9 the firmest.

Pungency Evaluation

Pungency was rated using a sensory panel following the organoleptic method described by Wall and Corgan (1992). A 1:5 scale was used:

- 1: Extremely mild.
- 5: Extremely pungent.

Taste panels evaluated inner, middle, and outer scales, cleansing their palates with water and apples between samples.

Beresta Content and Shelf Life Testing

Beresta (caramelized onions) was prepared by slow cooking sliced onions in oil until browned. Percent Beresta content was calculated using the dry matter estimation procedure. Shelf life tests were conducted with 25 kg of healthy, uniform bulbs per variety, stored under ambient conditions for six months (15 April to 15 October 2024).

Storage Loss Assessment

Total storage loss (%) was calculated as the sum of sprouting loss (%), physiological weight loss (%), and rotting loss (%).

Statistical Analysis

All recorded data were statistically analyzed using methods suggested by Gomez and Gomez (1984). Treatment means were compared using the least significant difference (LSD) test to determine significance at 5% and 1% levels.

RESULTS

The table presents the quality characteristics of onion bulbs stored using wooden platforms and cemented floors, with key attributes evaluated, including storage loss, bulb dry yield, firmness, dry matter (DM), total soluble solids (TSS), and pungency. The results are statistically analyzed, with coefficients of variation (CV %), least significant differences (LSD), and significance levels provided to assess variability and differences (Table 1 and 2).

Wooden platform storage showed significantly lower storage loss (21.8%) compared to cemented floor storage (27.1%). The LSD value (2.9%) confirms that the observed difference is statistically significant at the 5% level. Cemented floor storage resulted in a higher dry yield (2.27 t/ha) compared to the wooden platform (1.29 t/ha). The significance at the 1% level indicates a highly reliable difference between the two storage methods.

Bulbs stored on wooden platforms exhibited greater firmness (8.00) than those on cemented floors (7.38). The observed differences are statistically significant at the 5% level. Wooden platform storage had the highest DM content (17.7%), significantly greater than the 14.2% observed for cemented floors. The variation is statistically significant at the 5% level (Table 1).

Wooden platforms also led to higher TSS (17.3 °Brix) compared to cemented floors (13.1 °Brix), indicating superior flavor concentration in bulbs stored on wooden platforms. This difference is significant at the 1% level, demonstrating a consistent and meaningful impact of storage method on TSS. Pungency scores were higher for bulbs stored on wooden platforms (3.00) than those on cemented floors (2.60), suggesting better flavor intensity in wooden platform storage. Although the difference is less pronounced, it remains statistically significant at the 1% level (Table 2).

Table1: Effect of Storage Conditions on Bulb Dry Yield, Firmness, and Dry Matter Content of Onion Bulbs (*Allium cepa* L.)

Variety	Bulb dryyield	Bulbfirmness(1-9scale)	Bulb drymatter(%)
Wooden platform	1.29	8.00	17.7
Cemented floor	2.27	7.38	14.2
CV(%)	6.02	2.05	7.2
LSD(0.05)	0.41	0.42	1.5
Levelofsig.	**	*	*

**Significant at 1% level of probability, *Significant at 5% level of probability

Table 2: Comparison of Storage Loss, Total Soluble Solids (TSS), and Pungency of Onion Bulbs (*Allium cepa* L.) Under Two Storage Conditions

Variety	Storage loss (%)	TSS of bulb (°brix)	Pungency (0-5 scale)
Wooden platform	21.8	17.3	3.00
Cemented floor	27.1	13.1	2.60
CV(%)	2.7	4.5	12.23
LSD(0.05)	2.9	1.7	0.28
Level of sig.	*	**	**

**Significant at 1% level of probability, *Significant at 5% level of probability

DISCUSSION

The study revealed considerable variations in the quality characteristics of onion bulbs, including dry matter (DM), total soluble solids (TSS), bulb firmness, pungency, dry yield, and storage loss, influenced by different storage techniques. The maximum Dry Matter (DM) Content (17.72%) was recorded in bulbs stored on wooden platforms, significantly higher than the 14.18% observed in cemented floor storage. This variation in DM content is likely attributed to genetic characteristics derived from the onion's ancestry. These findings align with Arya *et al.* (2017), who reported that storage conditions significantly influenced DM content in onion bulbs.

The highest Total Soluble Solids (TSS) content (17.3 °Brix) was consistently obtained in bulbs stored on wooden platforms, followed by 13.08 °Brix for bulbs stored on cemented floors. This variability in TSS among storage conditions might result from inherent genetic traits of the onions, corroborating similar observations made by Arya *et al.* (2017). Bulb Firmness also exhibited notable differences, with the lowest firmness (6.38) observed in bulbs stored on cemented floors. The variation in firmness could be linked to genetic differences among the onion varieties studied.

Pungency (flavor perception) scores for pungency ranged between 4.60 and 5.00, with the strongest pungency (5.00) recorded in bulbs stored on wooden platforms and a slightly lower value (4.60) on cemented floors. These differences are likely influenced by the genetic potential of the onions, supporting findings by Wall and Corgan (1992), who also reported significant variations in pungency among onion varieties. The highest dry yield (3.27 t/ha) was achieved in bulbs stored on cemented floors, which outperformed the wooden platform in this regard. This superior performance is attributed to the higher fresh yield of onion bulbs on the cemented floor. In contrast, despite having the highest DM content, the wooden platform resulted in the lowest dry yield due to its reduced fresh yield. Similar variability in dry yield based on storage conditions has been reported by Walle *et al.* (2018).

Storage Loss, the lowest storage loss (41.81%) was observed in bulbs stored on wooden platforms, compared to 47.05% for those stored on cemented floors. The reduced storage loss in wooden platform storage is likely due to its association with higher DM, TSS, bulb firmness, and pungency. This observation aligns with Mahanthesh *et al.* (2008), who suggested that higher DM content enhances the storage longevity of onions. Additionally, Rabbani *et al.* (1986) also reported significant variability in storage loss among different onion varieties.

CONCLUSION

The results of the study demonstrate that storage methods significantly influence the quality and yield characteristics of onion bulbs. The wooden platform storage method consistently preserved superior quality attributes, including lower storage loss (21.8%), higher bulb firmness (8.00), greater dry matter content (17.7%), elevated total soluble solids (17.3 °Brix), and improved pungency (3.00). These qualities are essential for maintaining onion bulb integrity during storage and enhancing consumer satisfaction. Conversely, the cemented floor storage method resulted in higher bulb dry yield (2.27 t/ha), suggesting its suitability for maximizing productivity. The study highlights that wooden platforms are more effective for quality retention, while cemented floors may be better suited for situations where yield is prioritized. Farmers and storage facilities should prioritize wooden platform storage for onion bulbs, as it consistently preserves critical quality attributes such as lower storage loss, higher dry matter content, firmness, TSS, and pungency, making it ideal for long-term storage and enhancing market value.

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