PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (11) 3539-3542 November, 2024

Evaluating the Impact of Various Storage Techniques on Longevity of Frafra Potato (*Solenostemon rotundifolius*) in the Upper East Region of Ghana

[*1]NINFAA, DA; [1]ANYINDANA, AW; [2]LENIA, M

*[*1]Department of Ecological Agriculture, School of Agriculture, Bolgatanga Technical University, Bolgatanga, Ghana.*
[2]Department of Hotel Catering and Institutional Management, School of Applied Science and Arts, Bolgatanga Technical University, Bolgatanga, Ghana

**Corresponding Author Email: aninfaa@yahoo.com*
**ORCID: https://orcid.org/0009-1199-5397*
**Tel: +233243786375*

Co-Authors Email: apass135@gmail.com; matlenia1@gmail.com

ABSTRACT: The Frafra potato (Solenostemon rotundifolius) has a limited shelf life, making it an underappreciated crop that plays a vital role in food security in northern Ghana. The results showed a significant difference across the types and storage techniques. Moisture loss was greater in the WAAP variety (78.78%) than in the Local variety (75.30%). Of all the storage techniques, grass storage had the least moisture loss (76.02%), while control had the greatest (78.64%). Pot storage completely inhibited sprouting, but pit storage produced the highest rate of sprouting (12.69%). The temperature in the grass storage was 32.44°C, while the temperature in the pot storage was 29.74°C. The study came to the conclusion that Frafra potato shelf life can be successfully extended up to 90 days with acceptable losses using standard storage methods, especially pot.

DOI: https://dx.doi.org/10.4314/jasem.v28i11.4

Cite this Article as: NINFAA, D. A; ANYINDANA, A. W; LENIA, M. (2024). Evaluating the Impact of Various Storage Techniques on Longevity of Frafra Potato (*Solenostemon rotundifolius*) in the Upper East Region of Ghana. *J. Appl. Sci. Environ. Manage.* 28 (11) 3539-3542

Dates: Received: 18 September 2024; Revised: 20 October 2024; Accepted: 05 November 2024; Published: 15 November 2024

Keywords; Postharvest Technology; Frafra Potato; variety; storage and shelf-life.

Frafra potato (Solenostemum rotundifolius) belongs to Labiatae and the genus Coleus family. The plant is known by different scientific names: Coleus rotundifolius, Coleus parviflorus, Plectranthus esculentus, and Coleus esculentus among others. It is also known by several common names including Sudan potato, Madagascar potato, Salaga potato etc. Azad *et al* (2017) reported that the Frafra potato is a herbaceous plant with a prostrate growth habit. It produces a cluster of edible small tubers at the base and at points along the stem and branches that touch the ground. It is cultivated extensively in the interior savannah areas of Ghana, Nigeria, Mali and Burkina Faso, in areas where there is adequate moisture supply.

In Ghana, Frafra potato is grown in districts such as Bulsa, Kassena-Nankana, Frafra, Bolgatanga, Nandom, Jirapa-Lambusie, Nawdowli, and Wa, located in the Upper East and Upper West regions. This crop significantly influences the social dynamics of the local communities. It is commonly thought that a meal of Frafra potato can keep individuals satiated for several hours (Sugri *et al*., 2013). Frafra potato serves as a crucial food security crop for farmers in the Upper East and Upper West Regions of northern Ghana. Effective storage post-harvest is vital to ensure a steady supply of potatoes to consumers during the offseason. Various storage methods are employed, including cold storage in controlled environments,

**Corresponding Author Email: aninfaa@yahoo.com*
**ORCID: https://orcid.org/0009-1199-5397*
**Tel: +233243786375*

regular room storage, underground methods, or even wrapping potatoes in straw and placing them under sheds or trees.

While some potatoes are consumed shortly after harvest, the majority are stored for future planting, often under suboptimal conditions. This can lead to losses from sprouting, respiration, moisture loss, and decay. Without proper preservation techniques, spoilage becomes a significant issue. Unfortunately, many small-scale farmers in Northern Ghana face financial constraints, which limits their ability to invest in adequate storage solutions or access cold storage facilities. Consequently, they may resort to distress sales, and while traditional storage methods could provide a solution, knowledge of these practices varies (Sugri *et al*., 2013).

Despite the development of modern storage technologies that can significantly prolong the shelf life of Frafra potatoes, such as cold storage systems, these solutions remain out of reach for resource-limited farmers, rendering them prohibitively expensive (Sugri *et al*., 2021). This situation contributes to a decline in both the production of and supply for this important crop. Thus, it is essential to thoroughly assess the indigenous storage methods utilized by communities in the Upper East region to enhance the preservation of their produce. Consequenntly, the objective of this paper is to assess the effect of different storage methods on the shelf life of Frafra pota (Solenostemum rotundifolius) in the Upper East Region of Ghana.

MATERIALS AND METHODS

This study was carried out at the demonstration field of the Department of Ecological Agriculture in Sumburungu, located in the Upper East Region of Ghana, from December 2021 to March 2022. According to Ghana Meteorological Agency (2022), Sumburungu is situated between longitudes 10° 15' W and 0° 5' E, and from latitudes 10° 30' N to 11° 8' N. The area receives annual rainfall between 800 and 1200 mm, with relative humidity (RH) varying significantly; it can drop to around 20% during the dry season and exceed 75% in the wet season.

This paper examines the impact of various traditional storage methods on two types of Frafra potato: the Local Variety and the West Africa Agriculture Project (WAAP) variety. The study focused on storage practices during the dry season, specifically from December to March. A split-plot in a CRD design was used at the experimental site with varieties as two main treatments and storage methods as three sub treatments which were replicated three times. The varieties were subjected to pot, pit and grass/straw storage methods which are mainly traditional. To determine the best method for the storage of Frafra potato. Six hundred tubers of each variety were used to assess each storage method and replicated three times under local conditions.

Tubers were weighed before storage and each week the selected samples were re-weighed, oven-dried at 60ºC and the dry matter was weighed as well. At the end of the three-month storage period, the following data were gathered; final tuber weight, and sprout number for shelf life. Samples were also taken for moisture determination every week using the formula. Minimum and maximum temperature and relative humidity of the storage environment and outside were recorded every two days using a dual-purpose digital hand-held device model number FJ718 made in China. Data resulting from individual parameters were subjected to analysis of variance using GenStat software version 12th and means separated at 5 per cent (p=0.05) least significant.

RESULTS AND DISCUSSION

Temperature readings over the storage period showed significant variation ($p<0.05$) among the storage methods as seen (Table 2) with average temperature readings ranging from 32.44°C to 33.76°C (Figure 1). The highest temperature over the whole period was recorded in week one (December) while the lowest was recorded in week seven (January) by which time the harmattan had set in fully thereby reducing temperatures. This relatively lower temperature enhances storability because freshly harvested frafra potatoes like other tuber crops contain more than 70% moisture and are highly perishable in nature, especially under higher temperatures. Frafra potato just like sweet potato is said to be a semi-perishable crop and can be stored for over 6 months at 3˚C - 4˚C in a cold store (Sain et al., 2022). High post-harvest losses (PHL) in fresh commodities such as frafra potatoes are attributable to poor storage weather conditions including temperature. With respect to the relative humidity of the storage environments during the storage period, the observation between the weeks, between the two varieties and among the storage methods were comparable ($p<0.05$) as seen (Tables 1 & 2) with average relative humidity readings ranging from 20.0% to 21.4% (Figure 1). Both the highest and lowest relative humidity (RH) over the whole period was recorded in the 6th and 7th week respectively (January). At Weeks 6 and 7, the harmattan season was at its peak and might have contributed to the low humidity recorded. The harmattan season is normally associated with low humidity. Thus, relative humidity increased with decreasing temperature. In Table 1, the varieties on their own showed significant differences

(P<0.05) with respect to the weight loss of the tubers. The weight loss of the tubers, however, ranged from 75.30 grams for local variety (LV) to 78.78 grams for West Africa Agriculture Project (WAAP).

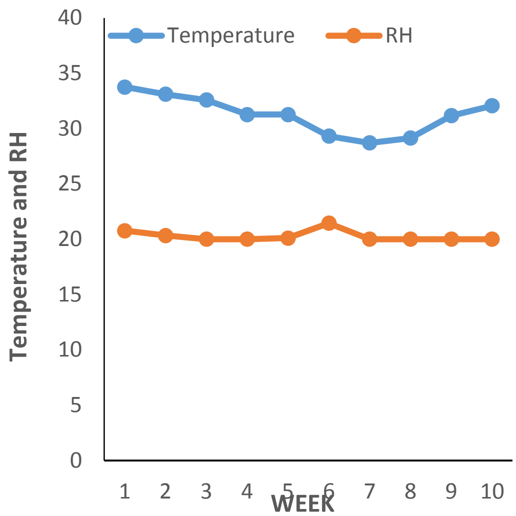

Fig 1. Temperature and Humidity of the Storage Environments

Table 1. Effect of Varieties on Moisture Content of Frafra Potato Tubers

Variety	%MC	% Sprout	Temperature	Relative Humility
LV	75.30[b]	4.12	30.99	20.283
WAAP	78.78[a]	3.47	30.99	20.258
LSD	1.574	2.540	1.109	0.4046

Effects of Varieties on Moisture Content (%): Moisture content decrease after harvest, reduces the quality of vegetable that need to be kept in fresh condition. Reduction in moisture of tubers due to evaporative losses from the tuber surface is considered as physiological moisture loss. Loss in moisture of tubers in storage usually occurs due to water loss, rotting and sprouting. Respiration and evaporation result in water loss and ultimately reduce the market quality of stored tubers.

Decrease in moisture content due to evaporation of water may be ten times greater than that of respiration loss. Significant differences were observed in the storage behavior of the two Frafra potato varieties. Continuous moisture content reduction throughout the entire period of about three months storage was recorded at every 7 days interval. At the end of the entire period of storage, maximum moisture content reduction was recorded in WAAP (78.78 %) which was statistically different (p<0.05), while minimum moisture reduction was found in LV (75.30 %). This could be attributed to the fact that the local variety has the inherent ability to withstand the hot weather conditions (higher temperature) as compared to WAAP as reported by (Gumbo, 2021). It is generally believed that varieties with longer dormancy periods may perform better under non-refrigerated storage conditions. It has been reported that sprouted potatoes lose much more weight than un-sprouted potatoes. Tutu et al. (2024) reported that moisture reduction in potato varieties during storage is related to the periderm thickness, the number of cell layers in the periderm and also with the number of lenticels on the tuber surface. Between the two varieties tested, the per cent moisture content was lower in the variety LV, while higher in WAAP during the storage period. Babajide (2008) also attributed moisture loss to higher temperatures that leads to high respiration and other metabolic activities and which is the main cause of moisture loss during storage. Sprouting is known to lead to increased respiration and dry matter loss and that affects shelf life. Moisture loss leads to economic loss and also makes products less attractive to potential buyers when put on the market. However, the two varieties were comparable to each other in sprouting. Thus, there was no significant difference between the two cultivars with respect to the total percentage of sprout, temperature and relative humidity after the storage period as can be seen in (Table 1) above.

Table 2. Effect of Different Traditional Storage Methods on Moisture Content of Frafra Potato

Storage Method	%MC	% Sprout	Temperature	Relative Humidity
Control	78.64[a]	1.39[b]	30.89[ab]	20.383
Pot	77.22[ab]	0.00[b]	29.74[b]	20.667
Pit	76.30[b]	12.69[a]	30.89[ab]	20.000
Grass	76.02[b]	1.11[b]	32.44[a]	20.033
LSD	*2.226*	*3.593*	*1.569*	*0.8092*

From Table 2, the differences among the individual storage methods affecting the two cultivars concerning moisture content reduction, percentage sprout and temperature were significant (P<0.05).

Effect of Different Traditional Storage Methods on Moisture Content of Frafra Potato: Loss of moisture by tubers was significantly affected by the methods of storage (P<0.05). Moisture content reduction in the control was the highest (78.64%) perhaps due to dehydration that occurred during the storage period as the tubers were stored in the open thus exposing the tubers to a higher temperature which could result in fast dehydration and moisture evaporation while storage in the pot, pit and grass were comparable. This could also be attributed to the protection offered by the pots, pits and grasses, therefore, regulating temperatures and reducing evaporation and dehydration.

All the three traditional storage methods (pot, pit and grass) showed great potential for preserving the tubers by reducing moisture loss. The reduced loss in moisture content could probably be due to the modification of the storage environment by the storage media. The tubers were given some protection by the pot, pit and grasses as the effect of the dry weather was mitigated to a large extent. Therefore, the effect of dehydration and evaporation were lessened thus prolonging the shelf life of the tubers and keeping them fresh and wholesome as reported by Gumbo (2021).

Effect of Different Traditional Storage Methods on Percentage Sprouting: Table 2 illustrates that different storage methods had significant variations in sprouting percentages ($P<0.05$). Pit storage had the highest sprouting rate at 12.69%, while pot storage maintained a sprouting rate of 0.00% throughout the entire period. This difference is likely due to the higher temperatures in the pits, while other storage methods showed similar results. The absence of sprouting in pot storage can be attributed to the cooling properties of the earthenware pots, which create a cooler environment that helps extend shelf life. The initiation of sprouting generally marks the end of the dormancy period in roots and tubers. Initiation of sprouting leads to increased respiration and dry matter loss.

The length of the dormancy period of Solenostemon rotundifolius is about two months (8 weeks). According to Babajide (2008), characteristics between species and storage methods vary considerably and this might have been responsible for differences in the treatments. Sprouting is also known to result in higher respiration and increased dry matter loss. Moisture content leads to economic loss and also makes products less attractive to potential buyers.

Conclusion: In conclusion, employing traditional storage methods such as pot, pit, and grass for Frafra potatoes enables farmers to manage their crops effectively for up to 90 days, minimizing losses. These techniques provide the flexibility to time sales for better prices during lean seasons, thus reducing postharvest losses and maximizing processed product output. Their cost-effectiveness and adaptability make them attractive to both small- and large-scale farmers. Given the crop's role in food security and income generation, these methods should be promoted alongside modern technologies. Enhancing local knowledge on Frafra potato storage can significantly alleviate hunger, improve nutritional status, and boost household incomes. This approach can be tailored to local conditions, allowing more resource-poor farmers to benefit. Ultimately, promoting these indigenous storage practices has the potential to reduce poverty and enhance resilience in communities, ensuring food availability during periods of scarcity (Sain *et al.*, 2022).

REFERENCES

Azad, AK; Kabir, H; Eaton, TEJ ; Soren, EB (2017). Potential storage methods for select exotic potato varieties under farmer conditions in Bangladesh. *Agri. Sci*. 8(2), 183-193. https://doi.org/10.4236/as.2017.82013

Babajide, JM; Henshaw, FO; Oyewole, OB (2008). The impact of yam varieties on the pasting characteristics and sensory qualities of traditional dried yam and its products. *J. Food Quality*. 31(3), 295-305.

FAO. (2009). International Year of the Potato 2008: Shedding light on a buried treasure; year-end report (p. 148). https://doi.org/10.1111/j.1745-4557.2008.00201

Gumbo, N (2021). Application of post-harvest chemical treatments to enhance shelf life of certain potato cultivars in South Africa. University of Johannesburg. https://doi.org/10.1016/j.jafr.2024.100974

Sain, A; Khamrai, D; Kandasamy, T; Naskar, D (2022). Exploring the role of sweet potato (Ipomoea batatas) in targeting protein tyrosine phosphatase 1B in obesity-related colon cancer. Proteins: Struct. Funct. Bioinform. 90(6), 1346-1362.

Sugri, I; Abubakari, M; Owusu, RK; Bidzakin, JK. (2021). Addressing postharvest losses and technology solutions: Insights from the Upper East Region of Ghana. Sustain. Fut' 3, 100048. https://doi.org/10.1016/j.sftr.2021.100048

Sugri, I; Kusi, F; Kanton, RAL;Nutsugah, SK; Zakaria, M (2013). Enhancing the sustainability of Frafra potato (Solenostemon rotundifolius Poir.) within the food supply chain: Opportunities in Ghana. *J. Plant Science*, 1(4), 68-75.

Tutu, CO;Amissah, JGN;Amissah, JN;Akonor, PT;Budu, AS; Saalia, FK. (2024). Evaluation of the physical, chemical, and rheological properties of flour from various accessions of Frafra potato (Solenostemon rotundifolius). *J. Agri. Food Res.* 15, 100974.