Original Research Article

**Effect of cultural practices on the dry matter, ash, total sugars, and reducing sugars contents of two varieties of *Dioscorea cayenensis-rotundata* ("Kangba" and "Kounougbé") during post-harvest storage**

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ABSTRACT

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| --- |
| **Aims:** To assess the influence of some cultural practices on biochemical composition of yam varieties "Kounougbé" and "Kangba" and their performance during post-harvest storage.  **Study design:** Analysis of Variance (ANOVA) was applied in this study.  **Place and Duration of Study:** Laboratory of Biocatalysis and Bioprocesses, during the period from December 2023 to June 2024  **Methodology:** Tubers of *Dioscorea cayenensis-rotundata* varieties *Kounougbé* and *Kangba*, cultivated under different cultural practices, were stored for six (6) months after harvest in an aired **storage**. Some biochemical parameters were analyzed at 0, 2, 4, and 6 months of storage.  **Results :** Dry matter, ash, and sugar contents significantly increased (*p* < 0.05) during storage, regardless of cultural practices. After six months, dry matter content ranged from 63.61 ± 0.05% to 73.42 ± 0.75%, compared to 35.58 ± 0.49% to 43.74 ± 0.42% in fresh tubers. Initially, chemically treated tubers exhibited lower dry matter content, but this trend reversed after two months. Chemical seed treatment and staking significantly influenced dry matter content (*p* < 0.05) at this stage. A similar trend was observed for ash. Chemical treatment significantly affected ash content initially, but differences became non-significant over time (p > 0.05). Chemical weeding resulted in higher ash content than manual weeding, particularly after two months. Cultural practices did not significantly affect sugar content (p > 0.05).  **Conclusion:** This study provides a scientific basis for improving yam storage, utilization, and valorization of yam verieties "Kounougbé" and "Kangba". Overall, the study's findings stress the importance of post-harvest storage in retaining the nutritional value of yam tubers, as well as the impact of specific cultural practices on the evolution of these parameters. Further research could investigate the underlying biochemical pathways and discover appropriate storage settings to preserve yam quality while minimizing post-harvest losses. |

*Keywords: Dioscorea cayenensis-rotundata*, post-harvest storage, dry matter, sugars, ash, cultural practices.

**1. INTRODUCTION**

Yam (*Dioscorea sp.*), a member of the Dioscoreaceae family, is a staple crop of significant economic and nutritional importance in West Africa, where it plays a crucial role in food security and rural economies (Mpika et al., 2024). It serves as a major carbohydrate source, providing over 50% of caloric intake in several countries (Benin, Côte d'Ivoire, Ghana, Nigeria...) and feeding approximately 300 million people worldwide (Price et al., 2017). In addition to its role as an energy source, yam is rich in fiber, proteins, and vitamins, making it nutritionally superior to many other tubers due to its high protein content (Mulualem et al., 2018). Tubers are dormant after harvest and the duration of the dormancy period in yams varies from 50 to 210 d depending on species, genotype, cultural practices, growing, and storage conditions (Datir et al. 2024). Botanically, cultivated yams are classified into two major species: *Dioscorea alata* and *Dioscorea cayenensis-rotundata* (Coulibaly et al., 2021). These species include several varieties, some of which have been characterized and processed, such as "Lokpa" (*D. cayenensis-rotundata*), "Florido", "Bètè Bètè", and "Nza" (*D. alata*) (Yeo & Soumahoro, 2022). Among them, yellow-fleshed yam varieties are particularly valued due to their high beta-carotene content, a precursor of vitamin A, which plays a vital role in combating nutritional deficiencies (Iglesias et al., 2018). Despite their nutritional benefits, yam production remains below expectations, particularly for yellow-fleshed varieties, due to several challenges, including soil degradation, pest infestations, weed competition, and unfavorable climatic conditions (Bakayoko et al., 2017; Barlagne & Blazy, 2011). These factors, along with limited availability of seed yams and post-harvest storage difficulties, reduce accessibility to these yams and lead farmers to prioritize higher-yielding or commercially preferred varieties (Tiama et al., 2016; Vernier, 2004). Numerous studies have examined the agromorphological and molecular characterization of yams, as well as their domestication and improvement strategies (Dansi et al., 1999; Scarcelli, 2005; Loko et al., 2013). Other research has focused on cultural practices adopted by farmers, such as pesticide application, crop rotation, mulching, weeding, and chemical fertilization. Among these practices, staking is often underutilized due to its high installation cost (Adifon et al., 2019). The impact of cultural practices on the post-harvest storage and biochemical composition of yellow-fleshed yam tubers remains largely unexplored, despite their significant nutritional and economic potential (Oko and Famurewa, 2014). Production constraints, including soil degradation, pest pressure, seed yam scarcity, and storage difficulties, directly affect the quality and availability of these yams. These limitations contribute to reduced yields and the gradual disappearance of local varieties, thereby restricting their role in food security and vitamin A deficiency prevention. Assessing the effects of cultural practices on the biochemical composition of yam tubers (dry matter, ash, total and reducing sugars) during post-harvest storage is therefore critical for enhancing their value and long-term sustainability. Thus, this study aims to determine the impact of cultural practices on the biochemical properties of stored yams, with the goal of optimizing their storage, utilization, and market potential.

**2. MATERIAL AND METHODS**

## **2.1 Plant material**

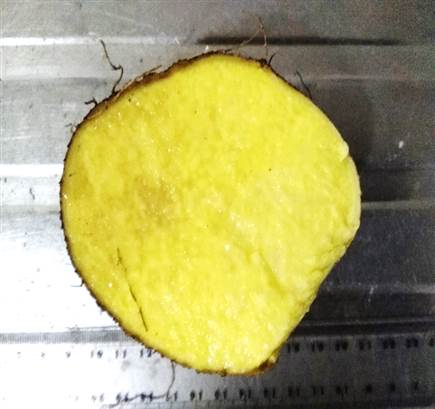
The plant material consisted of tubers from two (02) yellow-fleshed varieties of *Dioscorea cayenensis-rotundata*, namely "Kounougbé" and "Kangba" (Fig 1 and Fig 2). These tubers were harvested at physiological maturity from experimental plots in the Bouaké department, where prior weed control had been conducted using both chemical and manual weeding. The experimental design followed a randomized layout established during cultivation. Furthermore, the tubers were obtained from seed yams that had either undergone chemical treatment or remained untreated, as well as from plants that were either staked or left unstaked.



**Fig. 1. Whole tuber (a) and transverse section (b) of *Dioscorea cayenensis-rotundata*, var\*. "Kounougbé".**

\*Variety





**Fig. 2. Whole tuber (a) and transverse section (b) of Dioscorea cayenensis-rotundata, var\*. "Kangba".**

## **2.2 Methods**

### **2.2.1** **Storage Technique**

Undamaged yam tubers were individually placed on shelves inside the storage facility. This facility was covered with metal roofing sheets and had no ceiling. Temperature and humidity levels were monitored using a thermo-hygrometer, recording an average temperature of 28.51 °C ± 2 °C and a relative humidity of 78.25% ± 3%.

### **2.2.2** **Preparation method for fresh yam tuber powders**

One (1) kilogram of tubers from each batch was washed with tap water and peeled using a stainless steel knife. The peeled tubers were then washed twice with distilled water and cut into thin slices. These slices were placed on aluminum foil and dried in a MEMMERT (Single DISPLAY) ventilated oven at 45 °C for 2 days. The resulting dried yam slices were ground using a Blender-type grinder (BINATONE BLG 550). The obtained flour was sieved through an AFNOR sieve with a 90 μm mesh size. After sieving, the yam powders were stored in glass bottles that had been pre-dried in an oven at 45 °C for 1 day, hermetically sealed, and labeled. The yam powder samples were then stored in a desiccator for further analysis.

### **2.2.3** **Proximate analysis**

The dry matter content was determined by drying in an oven at 105°C during 24 hours to constant weight (AOAC, 1990). The ash content was determined by incinerating in a furnace at 550°C (AOAC, 1990). The method described by Dubois et al. (1956) was used for the total sugars content analysis and the reducing sugars content according to the method of Bernfeld (1955) using 3.5 dinitrosalycilic acids (DNS).

**2.2.4 Statistical Analysis**

All analyses reported in this study were carried out in triplicate. For each parameter, the mean value and standard deviation were calculated. A three-way ANOVA was performed, and mean separation was conducted using the Newman-Keuls Multiple Range test at *p* ≤ 0.05, with the assistance of STATISTICA 7.1 software (StatSoft Inc., Tulsa, USA Headquarters).

# 3. RESULTS AND DISCUSSION

## **3.1 RESULTS**

### **3.1.1** **Dry Matter Content**

The dry matter content of tubers from the yam varieties "Kounougbé" and "Kangba" varied during post-harvest storage, regardless of cultivation practices (Table 1). Specifically, these contents ranged from 35.58 ± 0.49% to 43.74 ± 0.42% in freshly harvested tubers, whereas after six (06) months of storage, they fluctuated between 63.61 ± 0.05% and 73.42 ± 0.75%. However, statistical analyses revealed that dry matter content significantly increased (p < 0.05) during post-harvest storage, regardless of the cultural practice. Regarding the tubers from chemically treated seed yams, the results showed that freshly harvested tubers had lower dry matter contents than those from untreated seed yams for the yam "Kounougbé" and "Kangba". These contents range from 40.38 ± 1.01% to 43.30 ± 0.33% for tubers from chemically treated seed yams, and between 41.14 ± 0.79% and 43.74 ± 0.42% for tubers from untreated seed yams of the "Kangba" variety. These contents ranged from 40.38 ± 1.01% to 43.30 ± 0.33% for tubers from chemically treated seed yams and from 41.14 ± 0.79% to 43.74 ± 0.42% for tubers from untreated seed yams of the "Kangba" variety. For the "Kounougbé" variety, they fluctuated between 35.58 ± 0.49% and 37.39 ± 0.46% for tubers from chemically treated seed yams, compared to values ranging from 36.19 ± 0.31% to 38.45 ± 0.94% for untreated ones. After two (02) months of storage, the dry matter contents of tubers from chemically treated seed yams exceed those of tubers from untreated seed yams. Statistical analyses indicated that chemical treatment of seed yams significantly (p < 0.05) influenced the dry matter content of tubers in both yam varieties at the beginning of post-harvest storage. Regarding staking, the results revealed that freshly harvested tubers from staked plants of the yam varieties "Kounougbé" and "Kangba" had lower dry matter contents than those from non-staked plants. For the "Kangba" variety, these contents ranged from 43.22 ± 0.65% to 43.74 ± 0.42% for tubers from non-staked plants, compared to values between 40.38 ± 1.01% and 42.22 ± 0.07% for tubers from staked plants. Similarly, for the "Kounougbé" variety, the dry matter content of tubers from non-staked plants ranged from 37.37 ± 0.72% to 38.45 ± 0.94%, compared to values from 35.58 ± 0.49% to 36.32 ± 0.58% for tubers from staked plants. However, after two (02) months of storage, tubers from staked plants exhibited higher dry matter contents than those from unstaked plants. Statistical analyses showed that staking significantly (p < 0.05) influenced the dry matter content of tubers from both yam varieties at the beginning of post-harvest storage. Statistical analyses showed that staking significantly (p < 0.05) affects the dry matter content of tubers in both yam varieties at the beginning of post-harvest storage. As for the chemical weeding, freshly harvested tubers from the yam varieties "Kounougbé" and "Kangba" harvested in chemically weeded plots exhibited lower dry matter contents than those from manually weeded plots. However, after two (02) months of storage, tubers harvested from chemically weeded plots showed higher dry matter contents than those from manually weeded plots. Furthermore, variance analysis indicated that the type of weeding had no significant effect (p < 0.05) on the dry matter content of tubers from the "Kounougbé" and "Kangba" yam varieties during post-harvest storage.

**Table 1. Dry matter content (%) of tubers from yams cultivated under different cultural practices during post-harvest storage**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety "Kangba" | | | | | | |
|  |  |  | Storage time (months) | | | |
| Weeding Type | Staking | Seed Treatment | 0 | 2 | 4 | 6 |
| Chemical | Staking | Cts | 40.38 ± 1.01a | 57.88 ± 0.60ef | 62.58 ± 0.26gh | 64.57 ± 0.28i |
| Us | 41.47 ± 0.38bc | 57.85 ± 0.46ef | 62.52 ± 0.37gh | 64.45 ± 0.20i |
| No  Staking | Cts | 43.22 ± 0.65d | 57.16 ± 0.24e | 61.73 ± 0.64g | 63.74 ± 0.96hi |
| Us | 43.72 ± 0.15d | 57.78 ± 0.44ef | 61.79 ± 0.14g | 63.61 ± 0.52hi |
| Manual | Staking | Cts | 41.14 ± 0.79ab | 57.80 ± 0.15ef | 62.76 ± 0.35gh | 64.59 ± 0.40i |
| Us | 42.22 ± 0.07c | 58.50 ± 0.55f | 62.84 ± 0.11gh | 64.01 ± 0.20i |
| No  Staking | Cts | 43.30 ± 0.33d | 56.91 ± 0.29e | 61.95 ± 0.24g | 63.61 ± 0.05hi |
| Us | 43.74± 0.42d | 57.00 ± 0.72e | 62.66 ± 0.76gh | 63.61 ± 0.14hi |
| Variety "Kounougbé" | | | | | | |
| Chemical | Staking | Cts | 35.58 ± 0.49a | 66.11 ± 0.41d | 69.43 ± 0.30e | 73.42 ± 0.75f |
| Us | 36.19 ± 0.31a | 66.39 ± 0.86d | 69.64 ± 0.38e | 72.42 ± 0.27f |
| No  Staking | Cts | 37.37 ± 0.72bc | 65.59 ± 0.27d | 68.69 ± 0.53e | 72.50 ± 0.32f |
| Us | 37.95 ± 0.14bc | 65.58 ± 0.34d | 68.80 ± 0.82e | 72.39 ± 0.44f |
| Manual | Staking | Cts | 36.20 ± 0.64a | 66.73 ± 0.43d | 69.86 ± 0.33e | 73.13 ± 0.75f |
| Us | 36.32 ± 0.58a | 66.35 ± 0.19d | 69.66 ± 0.43e | 73.21 ± 0.14f |
| No  Staking | Cts | 37.39 ± 0.46b | 65.67 ± 0.58d | 69.31 ± 0.42e | 72.51 ± 0.68f |
| Us | 38.45 ± 0.94c | 65.78 ± 0.35d | 69.66 ± 0.19e | 72021 ± 0.13f |

*Mean ± standard deviation; n=3.*

*For each variety, means in the same column or row without a common letter differ significantly (p ≤ 0.05) according to the Newman-Keuls test.*

*Cts: Chemically treated seed yams; Us: Untreated seed yams.*

### **3.1.2** **Ash Content**

The ash content of tubers from the yam varieties "Kounougbé" and "Kangba" significantly increased (p < 0.05) during post-harvest storage, regardless of the cultural practice (Table 2). These contents ranged from 1.59 ± 0.04 to 2.56 ± 0.01 g/100g of dry matter (DM) in freshly harvested tubers, whereas they varied from 2.07 ± 0.02 to 2.85 ± 0.04 g/100g DM after six (06) months of storage.Regarding the tubers from chemically treated seed yams, the results showed that freshly harvested tubers had higher ash contents than those from untreated seed yams for the yam varieties "Kounougbé" and "Kangba." These contents ranged from 1.70 ± 0.01 g/100g of dry matter (DM) to 1.85 ± 0.04 g/100g DM for tubers from chemically treated seed yams and from 1.59 ± 0.04 g/100g DM to 1.68 ± 0.02 g/100g DM for tubers from untreated seed yams of the "Kangba" variety. Regarding tubers derived from chemically treated seed yams, results showed that freshly harvested tubers had higher ash content compared to those from untreated seed yams in both yam varieties. Ash content ranged from 1.70 ± 0.01 to 1.85 ± 0.04 g/100g DM for tubers from chemically treated seed yams and from 1.59 ± 0.04 to 1.68 ± 0.02 g/100g DM for tubers from untreated seed yams of the "Kangba" variety. In the "Kounougbé" variety, values fluctuated between 2.32 ± 0.01 and 2.37 ± 0.01 g/100g DM for tubers from chemically treated seed yams, compared to 2.50 ± 0.02 and 2.56 ± 0.01 g/100g DM for untreated ones. After two (02) months of storage, the ash content of tubers from chemically treated seed yams remained relatively higher than that of tubers from untreated seed yams. Furthermore, variance analysis indicated that seed yam treatment significantly affected (p < 0.05) the ash content at the beginning of storage. Consequently, significant differences (p < 0.05) were observed between the ash contents of tubers from untreated and chemically treated seed yams for both yam varieties. However, differences in ash content became non-significant (p > 0.05) as storage progressed. With regard to staking, the results showed that freshly harvested tubers from staked plants of the yam varieties "Kounougbé" and "Kangba" exhibited higher ash contents than those from unstaked plants. For the "Kangba" variety, these contents ranged from 1.62 ± 0.01 g/100g of dry matter (DM) to 1.84 ± 0.04 g/100g DM for tubers from staked plants, compared to values between 1.59 ± 0.04 g/100g DM and 1.85 ± 0.04 g/100g DM for tubers from unstaked plants. Similarly, for the "Kounougbé" variety, the ash content of tubers from staked plants ranged from 2.35 ± 0.03 g/100g DM to 2.56 ± 0.01 g/100g DM, whereas values ranged from 2.32 ± 0.01 g/100g DM to 2.51 ± 0.01 g/100g DM for tubers from unstaked plants. However, after two (02) months of storage, tubers from staked plants exhibited relatively higher ash contents than those from unstaked plants. Regarding chemical weeding, freshly harvested tubers from the yam varieties "Kounougbé" and "Kangba" in chemically weeded plots had relatively higher ash contents than those harvested from manually weeded plots. Nevertheless, after two (02) months of storage, tubers harvested from chemically weeded plots continued to show relatively higher ash contents than those from manually weeded plots. Furthermore, chemical weeding did not significantly (p > 0.05) impact the ash content during post-harvest storage.

**Table 2. Ash content (g/100g de MS) of tubers from yams cultivated under different cultural practices during post-harvest storage**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety "Kangba" | | | | | | |
|  |  |  | Storage time (months) | | | |
| Weeding  Type | Staking | Seed  Treatment | 0 | 2 | 4 | 6 |
| Chemical | Staking | Cts | 1.84 ± 0.04de | 1.97 ± 0.10efghij | 2.05 ± 0.03ghijkl | 2.16 ± 0.02 kl |
| Us | 1.62 ± 0.01a | 1.85 ± 0.05def | 1.98 ± 0.09efghij | 2.13 ± 0.07jkl |
| No  Staking | Cts | 1.85 ± 0.04def | 1.93 ± 0.03defgh | 2.01 ± 0.08fghijk | 2.11 ± 0.07ijkl |
| Us | 1.59 ± 0.04a | 1.78 ± 0.08bcd | 2.12 ± 0.14jkl | 2.22 ± 0.02l |
| Manual | Staking | Cts | 1.82 ± 0.01cde | 1.93 ± 0.02defgh | 1.95 ± 0.03efghi | 2.07 ± 0.02hijkl |
| Us | 1.64 ± 0.04ab | 1.90 ± 0.02defg | 2.05 ± 0.04ghijkl | 2.16 ± 0.03kl |
| No  Staking | Cts | 1.70 ± 0.01abc | 1.91 ± 0.04defgh | 2.06 ± 0.17ghijkl | 2.12 ± 0.01jkl |
| Us | 1.68 ± 0.02ab | 1.89 ± 0.01defg | 2.19 ± 0.03l | 2.11 ± 0.02ijkl |
| Variety "Kounougbé" | | | | | | |
| Chemical | Staking | Cts | 2.56 ± 0,01defghi | 2.64 ± 0.07defghij | 2.69 ± 0,01efghijk | 2.71 ± 0.06fghijk |
| Us | 2.37 ± 0,01abc | 2.63± 0.06defghij | 2.71 ± 0,02ghijk | 2.63 ± 0.10jk |
| No  Staking | Cts | 2.51 ± 0,01bcde | 2.72 ± 0.03hijk | 2.75 ± 0,05ijk | 2.77 ± 0.07ijk |
| Us | 2.34 ± 0,05ac | 2.51 ± 0.04bcdef | 2.78± 0,06jk | 2.76 ± 0.08ijk |
| Manual | Staking | Cts | 2.53 ± 0,01bdefgh | 2.72 ± 0.04hijk | 2.57 ± 0,14defghi | 2.75 ± 0.11ijk |
| Us | 2.35 ± 0,03abc | 2.64 ± 0.12defghij | 2,67 ± 0,12efghijk | 2.76 ± 0.06ijk |
| No  Staking | Cts | 2.50 ± 0,02bde | 2.51 ± 0.01bdefg | 2.64 ± 0,05defghij | 2.72 ± 0.15ghijk |
| Us | 2.32 ± 0,01a | 2.45 ± 0.02abcd | 2.59 ± 0,09defghij | 2.85 ± 0.04k |

*Mean ± standard deviation; n = 3.*

*For each variety, means in the same column or row without a common letter differ significantly (p ≤ 0.05) according to the* *Newman-Keuls test.*

*Cts: Chemically treated seed yams; Us: Untreated seed yams.*

### **3.1.3** **Total and reducing sugars**

The total and reducing sugar contents of the tubers from the "Kounougbé" and "Kangba" varieties of *Dioscorea cayenensis-rotundata* significantly increased (*p* < 0.05) during post-harvest storage, regardless of the cultural practice (Tables 3 and 4). The total sugar content of freshly harvested tubers from these yam varieties ranged from 3.06 ± 0.11 to 3.53 ± 0.02 g/100 g of dry matter (DM), while reducing sugars varied from 0.72 ± 0.02 to 0.86 ± 0.01 g/100 g DM. After six (06) months of storage, the total sugar content ranged from 5.93 ± 0.09 to 8.35 ± 0.40 g/100 g DM, whereas reducing sugars were between 1.23 ± 0.01 and 1.32 ± 0.01 g/100 g DM (Tables 3 and 4). However, cultural practices, including the type of weeding, staking, and seed tuber treatment, did not significantly influenced (*p* > 0.05) the total and reducing sugar contents of the tubers from the "Kounougbé" and "Kangba" yam varieties, regardless of the storage time.

**Table 3. Total sugar (g/100 g DM) of tubers from yams cultivated under different cultural practices during post-harvest storage**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety "Kangba" | | | | | | |
|  |  |  | Storage time (months) | | | |
| Weeding  Type | Staking | Seed  Treatment | 0 | 2 | 4 | 6 |
| Chemical | Staking | Cts | 3.27 ± 0.04a | 4.15 ± 0.30b | 5.15 ± 0,11c | 6.24 ± 0.26d |
| Us | 3.25 ± 0.30a | 4.13 ± 0.19b | 5.09 ± 0,10c | 6,15 ± 0.17d |
| No  Staking | Cts | 3.23 ± 0.14a | 3.73 ± 0.59b | 5.16 ± 0,16c | 5.93 ± 0.09d |
| Us | 3.06 ± 0.11a | 3,84 ± 0.05b | 4.82 ± 0,49c | 5.99 ± 0.13d |
| Manual | Staking | Cts | 3.09 ± 0.08a | 3.87 ± 0.04b | 4.87 ± 0,04c | 6.05 ± 0.10d |
| Us | 3.20 ± 0.07a | 4.10 ± 0.30b | 5.13 ± 0,30c | 6.05 ± 0.08d |
| No  Staking | Cts | 3.13 ± 0.25a | 3.91 ± 0.16b | 4.95 ± 0,14c | 5.95 ± 0.20d |
| Us | 3.19 ± 0.14a | 3.86 ± 0.39b | 4.86 ± 0,06c | 5.92 ± 0.18d |
| Variety "Kounougbé" | | | | | | |
| Chemical | Staking | Cts | 3.25 ± 0.12a | 3.93± 0.43bc | 5.83 ± 0.30d | 8.35 ± 0.40e |
| Us | 3.26 ± 0.23a | 3.94 ± 0.09bc | 5.78 ± 0.56d | 8.07 ± 0.19e |
| No  Staking | Cts | 3.19 ± 0.32a | 4.11 ± 0.35bc | 5.99 ± 0.16d | 7.95 ± 0.37e |
| Us | 3.24 ± 0.29a | 3.89 ± 0.19bc | 5.90 ± 0.14d | 7.92 ± 0.17e |
| Manual | Staking | Cts | 3.53 ± 0.02ab | 4.20 ± 0.09c | 5.59 ± 0.30d | 8.20 ± 0.10e |
| Us | 3.27 ± 0.11a | 3.75 ± 0.23abc | 5.70 ± 0.33d | 8.02 ± 0.08e |
| No  Staking | Cts | 3.24 ± 0.03a | 3.93 ± 0.01bc | 5.87 ± 0.35d | 8.07 ± 0.19e |
| Us | 3.19 ± 0.08a | 4.06 ± 0.13bc | 5.62 ± 0.09d | 8.00 ± 0.12e |

*Mean ± standard deviation; n = 3.*

*For each variety, means in the same column or row without a common letter differ significantly (p ≤ 0.05) according to the Newman-Keuls test.*

*Cts: Chemically treated seed yams; Us: Untreated seed yams.*

**Table 4. Reducing sugar (g/100 g DM) of tubers from yams cultivated under different cultural practices during post-harvest storage**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety "Kangba" | | | | | | |
|  |  |  | Storage time (months) | | | |
| Weeding  Type | Staking | Seed  Treatment | 0 | 2 | 4 | 6 |
| Chemical | Staking | Cts | 0.72 ± 0.02a | 0.91 ± 0.01b | 1.04± 0.05c | 1.25 ± 0.01d |
| Us | 0.74 ± 0.03a | 0.90 ± 0.01b | 1.04 ± 0.01c | 1.28 ± 0.01d |
| No  Staking | Cts | 0.76 ± 0.02a | 0.92 ± 0.02b | 1.04 ± 0.02c | 1.27 ± 0.01d |
| Us | 0.77 ± 0.02a | 0.91 ± 0.01b | 1.04 ± 0.01c | 1.26 ± 0.02d |
| Manual | Staking | Cts | 0.77 ± 0.02a | 0.92 ± 0.02b | 1.02 ± 0.01c | 1.23 ± 0.01d |
| Us | 0.73 ± 0.01a | 0.91 ± 0.01b | 1.04 ± 0.02c | 1.27 ± 0.01d |
| No  Staking | Cts | 0.74 ± 0.04a | 0.92 ± 0.02b | 1.03 ± 0.01c | 1.24 ± 0.04d |
| Us | 0.74 ± 0.01a | 0.90 ± 0.01b | 1.02 ± 0.01c | 1.23 ± 0.04d |
| Variety "Kounougbé" | | | | | | |
| Chemical | Staking | Cts | 0.86 ± 0.04a | 0.93 ± 0.02b | 1.23 ± 0.01c | 1.32 ± 0.01d |
| Us | 0.86 ± 0.03a | 0.93 ± 0.01b | 1.20 ± 0.01c | 1.31 ± 0.01d |
| No  Staking | Cts | 0.83 ± 0.02a | 0.95 ± 0.01b | 1.22 ± 0.02c | 1.30 ± 0.02d |
| Us | 0.82 ± 0.02a | 0.95 ± 0.02b | 1.21 ± 0.01c | 1.31 ± 0.01d |
| Manual | Staking | Cts | 0.86 ± 0.01a | 0.94 ± 0.01b | 1.22 ± 0.02c | 1.31 ± 0.01d |
| Us | 0.85 ± 0.03a | 0.94 ± 0.01b | 1.22 ± 0.01c | 1.32 ± 0.02d |
| No  Staking | Cts | 0.84 ± 0.04a | 0.96 ± 0.02b | 1.22 ± 0.01c | 1.32 ± 0.01d |
| Us | 0.84 ± 0.02a | 0.96 ± 0.02b | 1.21 ± 0.02c | 1.32 ± 0.01d |

*Mean ± standard deviation; n = 3.*

*For each variety, means in the same column or row without a common letter differ significantly (p ≤ 0.05) according to the Newman-Keuls test.*

*Cts: Chemically treated seed yams; Us: Untreated seed yams.*

## **3.2 DISCUSSION**

The dry matter content of the tubers from the yam varieties "Kounougbé" and "Kangba" significantly increased (*P* < 0.05) during storage, regardless of the cultural practice. This suggests that the tubers undergo post-harvest dehydration, as reported by Medoua (2005). This dehydration is mainly linked to the progressive reduction of water content in the tuber tissues (Trèche, 1989). Furthermore, a similar increase in dry matter content was observed by Djè et al. (2010a) during storage, with levels reaching 71.49% for the "Bètè Bètè" variety and 63.98% for "Kangba"after six months. According to these authors, this phenomenon could be attributed to the germination process, which leads to increased respiratory intensity and accelerated transpiration, thereby promoting water loss and concentration of dry matter. The results obtained from freshly harvested tubers align with those reported for 48 cultivars of *Dioscorea rotundata* by Fakorede et al. (2020), who recorded dry matter content ranging from 28.24% to 43.07%. Analysis of variance revealed significant influences (*p* < 0.05) of staking and chemical treatment of seed tubers on the dry matter content at the beginning of storage. This result suggests that these cultural practices directly or indirectly modify physiological processes involved in the accumulation or redistribution of dry compounds in the tubers. The dry matter content of staked yam tubers significantly differed (*p* < 0.05) from that of unstaked tubers, with higher values observed in unstaked tubers at the beginning of storage. Regarding the chemical treatment of seed tubers, the highest initial dry matter levels were recorded in tubers from "Kounougbé" and "Kangba" varieties grown from untreated seed tubers. This could be explained by a lower water content in their tissues, as noted by Trèche (1989), leading to a higher concentration of dry matter. These findings indicated that tubers from "Kangba"and "Kounougbé" varieties cultivated without staking or chemical treatment initially contain less water, which could slow down their deterioration during storage. However, after six months of storage, the highest dry matter content was observed in tubers subjected to staking and/or grown from chemically treated seed tubers. This observation suggests that these tubers lose a significant amount of water during post-harvest storage. Indeed, their initially high water content constitutes a perishable factor, which could explain their shorter shelf life and increased tendency to sprout rapidly (Kuagny, 2022). Similar observations were reported by Hannaniah et al. (2022), who found that chemical treatment of seed tubers with the insecticide Perfect Killer enhanced germination while negatively affecting certain growth parameters and the biochemical composition of plants. Overall, these findings highlight the need to optimize cultural practices to balance yield benefits and post-harvest storage quality. Furthermore, these samples would be less stable than the untreated ones due to significant dehydration occurring in the second month of storage. The study also indicated that the ash content of the tubers from "Kounougbé" and "Kangba"yam varieties significantly increased (*p* < 0.05) during post-harvest storage, regardless of the cultural practice. This increase may be attributed to the higher concentration of minerals resulting from water loss during storage (Mendez & Ordoñez, 2009). Additionally, it could also be explained by passive variations related to changes in carbohydrate content over time (Trèche, 1989). Our results are in agreement with those of Medoua et al. (2005), who observed a significant increase (*p* < 0.05) in ash content in yellow *Dioscorea dumetorum* tubers after 56 days of storage. The ash contents obtained in this study are in agreement with those reported by Tortoe et al. (2017), who analyzed flours from seven yam(*Dioscorea* *spp*.) varieties and recorded values ranging from 1.81 to 2.73 g/100 g. Moreover, Induar et al. (2023) reported an ash content of 2.57% for *Dioscorea bulbifera*. Mineral matter plays a crucial role in numerous biochemical reactions, contributing to the physiological functioning of key metabolic processes in the human body (Bamishaiye et al., 2011). The analysis of variance revealed a significant influence (*p* < 0.05) of staking and chemical treatment of seed tubers on ash content at the beginning of storage and then slightly during storage. After six months of storage, the highest ash contents were observed in tubers from unstaked "Kounougbé" and "Kangba" yam plants, whereas tubers from staked plants exhibited lower ash contents. These results suggest that staking may reduce ash content during storage, corroborating the findings of Trèche & Agbor (1986) and Trèche (1989), who reported a decrease in ash content in *D. dumetorum* tubers subjected to this cultural practice. At the beginning of storage, the highest ash contents were observed in tubers from chemically treated seed tubers. This could be attributed to improved mineral absorption from the soil induced by chemical treatment (Soro et al., 2010). Such treatment is also known to enhance root, shoot, and tuber formation (Cabanillas & Martin, 1978). However, after six months of storage, the highest ash contents were found in tubers from untreated seed tubers, suggesting that these tubers lose fewer minerals over time. This observation may reflect better mineral retention in tubers from untreated seed tubers during storage, possibly due to structural composition differences or metabolic mechanisms. Regarding total and reducing sugar contents in yam tubers, a significant increase (*p* < 0.05) was observed during storage, regardless of the cultural practice. The increase in total sugars could be explained by the transformation of other carbohydrates or by the concentration of sugars resulting from water loss or the dissipation of other components during storage. Furthermore, the increase in reducing sugars could be attributed to the progressive breakdown of starch into reducing sugars, a common process during tuber storage. This increase is likely due to the hydrolysis of starch by amylolytic enzymes present in the tubers (Diopoh & Kamenan, 1981). It may also result from the post-harvest degradation and subsequent hydrolysis of starch into sugar (Afoakwa & Sefa-Dedeh, 2001). In line with our findings, a comparative study by Moses et al. (2017) on *Dioscorea rotundata*, *Dioscorea alata*, and *Dioscorea cayenensis* after four months of ambient storage revealed an increase in total sugars. As for the reducing sugar content, Djè et al. (2010b) observed a significant increase (*p* < 0.05) during storage. According to these authors, the initial reducing sugar content ranged from 0.73 to 0.91 g/100 g dry matter (DM) in different parts of freshly harvested yam tubers, rising to values between 1.12 and 1.37 g/100 g DM for "Kangba"and "Bètè Bètè" cultivars after six months of storage. Their findings agreed with the sugar contents observed in this study. Concerning total sugar content, our values corroborated those reported by Otegbayo et al. (2011), Wireko-Manu et al. (2011), and Adepoju et al. (2018), who recorded values ranging from 1.9 g to 4.6 g/100 g DM for *Dioscorea cayenensis-rotundata* yam tubers.

# 4. CONCLUSION

The study showed that chemical treatment of seed yams and staking have a significant effect on dry matter and ash content at the beginning of storage. However, after two months of storage, this influence gradually diminishes over time. In contrast, the effect of chemical weeding is not significant on dry matter, ash content, and total and reducing sugars. Moreover, this study highlighted the significant increase in various parameters of the yam tubers 'Kounougbé' and 'Kangba' during post-harvest storage, regardless of the cultural practice used. Overall, the study results emphasize the importance of post-harvest storage in preserving the nutritional value of yam tubers and reveal the impact of certain cultural practices on the evolution of these parameters. Further research could explore the underlying biochemical mechanisms and identify optimal storage conditions to maintain yam quality while minimizing post-harvest losses

# DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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