



eISSN 2239-7132

Italian Journal of Food Safety

<https://www.pagepressjournals.org/index.php/ijfs/index>

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Ital J Food Saf 2026 [Online ahead of print]

Please cite this article as:

Sanou OD, Ouédraogo I, Tou R, et al. **Potential impacts of sales practices on the postharvest quality of yams in Burkina Faso.** *Ital J Food Saf* doi:10.4081/ijfs.2026.14458

Submitted: 23-09-2025

Accepted: 26-01-2026

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Potential impacts of sales practices on the postharvest quality of yams in Burkina Faso

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Key words: yams, rotting, drying, storage condition, socio-economic and demographics.

Contributions: Ouryagala Dominique Sanou: writing - original draft preparation. Idrissa Ouedraogo: writing - review and editing. Ramata Tou: formal analysis. Balamoussa Santara: data curation, methodology. Kiessoun Konate: supervision, editing. Lassina Ouattara: supervision.

Conflict of interest: the authors declare that they have no competing interests.

Ethics approval and consent to participate: not applicable.

Participant consent: the consent of the respondents was obtained before the surveys.

Availability of data and materials: the datasets used and/or analyzed during the current study are available upon reasonable request from the corresponding author.

Acknowledgments: the authors wish to thank the vendors for their collaboration. The authors gratefully acknowledge the support of the Directorate General of University Guidance and Scholarships of Burkina Faso.

Abstract

Yams are a major staple food in Burkina Faso, consumed both raw and processed. This study investigated yam marketing practices and the socio-demographic and socio-economic profiles of sellers in the markets in Burkina Faso. Data were collected through questionnaires covering age, gender, varieties, storage conditions, and yam prices, complemented by direct observations of sales and storage methods. Results showed that yam marketing is largely dominated by women, with most sellers being young and averaging 10 years of experience, while older sellers tended to have longer experience. Nearly half of the respondents (48%) had no formal schooling. The main varieties marketed were American (49%), Gona (36%), and Tila (8%), belonging to *Dioscorea alata* and *Dioscorea rotundata-cayenensis*. Storage practices revealed that 59% of sellers kept yams in the open air, whereas 41% used closed containers, resulting in estimated postharvest losses of 76% from rotting, 18% from drying, and 6% from softening. Rotting was mainly associated with inadequate storage conditions (49%), high temperatures (32%), fertilizer use (14%), and pesticides (5%). Most yams originated from local production areas, particularly Gaoua (21%), Bobo-Dioulasso (11%), Banfora (8%), and Mangodara (6%). Sellers primarily sourced supplies from wholesalers and farmers, who also stored yams before sale. Market prices ranged from 200 to 700 F CFA/kg. Beyond its dietary role, the yam trade represents an important economic activity, with daily earnings varying between 2000 and more than 50,000 F CFA depending on the variety and seller type. These findings highlight the need to improve sales and storage practices to reduce losses, enhance yam quality, and protect consumer health.

Introduction

Roots and tubers are starchy plants cultivated for their underground organs rich in starch and, except for yams, for their leaves rich in protein, mineral (zinc, iron), and vitamin (A, C) (FAO, 2021). Worldwide consumption of root and tuber is around 70 kg per capita per year (FAO, 2021). In many African countries, root and tuber crops constitute a major component of the diet, as reflected by their high per capita consumption levels. Annual cassava consumption is estimated at approximately 250 kg in Congo and 220 kg in Ghana. In Nigeria, per capita consumption reaches nearly 120 kg for cassava and 105 kg for yams, while in Benin it is around 110 kg for cassava and 155 kg for yams (FAOSTAT, 2021). Among these crops, yams (*Dioscorea spp.*) account for an estimated global production of 75 million tons, with Africa contributing approximately 98% of total output (FAO, 2021). As a result, they significantly contribute to food intake for over 500 million people in tropical African countries. Yams play an essential role in food security for populations in a context of climate change and strong population growth because of their ability to grow in marginal environments where many other crops perform poorly (Onyeka *et al.*, 2006). In Burkina Faso, according to the sectoral statistics department, yams production was 62,662 tons in 2023, with an average consumption of 5.89 kg/person/year.

Unfortunately, in Burkina Faso, strategies of contribution to food sovereignty rarely take into account secondary crops, such as yams (Sory *et al.*, 2024). Yams are often underutilized. However, due to their high content of carbohydrates, proteins, vitamins, and minerals, yams are an essential source of energy for low-income or poor people. Beyond their nutritional importance, yams also represent a source of income for many rural households and contribute to diversifying the diets of populations. Yams also exhibit medicinal properties. The combined presence of high potassium and sodium levels suggests a potential role in the prevention of osteoporosis and certain cardiovascular diseases.

In line with global strategies promoting crop diversification and the valorization of underutilized species to enhance food security (FAO, 2012), yams hold significant potential. Despite this potential, yams are undermined by substantial post-harvest losses caused by pest infestations and fungal rots, which limit market opportunities, weaken value chains, and pose risks to food safety and public health (Esheli *et al.*, 2022).

A better understanding of the different varieties of roots and tubers marketed and the conditions under which they are marketed is therefore necessary to strengthen the contribution of this crop to national

food security. In this context, our study aims to investigate yam marketing practices and the socio-demographic and socio-economic profiles of sellers in Burkina Faso.

Materials and Methods

Study area

The study was conducted among yam sellers (wholesalers and retailers) between July and September 2025 on major urban markets in Bobo-Dioulasso, Gaoua, and Ouagadougou (Figure 1). These locations were selected due to their strategic role in the yam trade and distribution across diverse socio-economic settings. The survey period coincided with the main yam harvesting season, ensuring the availability of fresh produce and capturing representative post-harvest handling and marketing practices.

Data collection methods

An explanatory mixed-methods design was employed, combining individual interviews with on-site observations, and relying on an exhaustive survey of all eligible yam sellers present at the selected markets during the study period. Overall, 100 face-to-face in-depth interviews were conducted, complemented by systematic field observations. The interview procedure began with a comprehensive explanation of the study's objectives and obtaining consent from the participants. Following predefined questions, the respondents were then interviewed for a duration of 10-15 min. The selection of participants and preparing open-ended questions was conducted using step-by-step sampling as recommended by Nyumba *et al.* (2018). The information collected mainly concerned socio-demographic characteristics such as age, level of education, and origin of yams, and socio-economic parameters such as selling prices and daily profitability. The sample size was determined using Schwartz's formula (Serhier *et al.*, 2020), assuming a 95% confidence level ($z=1.96$), a conservative population proportion of 50%, and a margin of error of $\pm 9.8\%$, which yielded a minimum sample size of 100 respondents [Eq. 1].

$$n = \frac{z^2 \times p(1-P)}{m^2} \quad [\text{Eq.1}]$$

Where, n is the sample size, $z=1.96$ for a 95% confidence level, p is the estimated proportion of the population exhibiting the characteristic (50%) and m is the allowed margin of error ($\pm 9.8\%$).

Data analysis

Quantitative and qualitative data were reported to Microsoft Excel, and data were analyzed using R-Studio software version 4.5.0 and Microsoft Excel version 16.72. A univariate analysis of the variables was conducted to provide a more specific description of each variable. A normality test was also performed to assess the distribution of each variable and verify its conformity to a normal distribution. For variables such as gender and education level, a chi-square test on proportions was performed to assess significant differences between categories, with a significance threshold set at $p < 0.05$. To assess the relationship between sellers' age and their number of years of experience in yam trading, we used the Pearson correlation coefficient. This analysis allows us to determine whether the two variables are linearly related. We performed a simple linear regression to model the relationship between the sellers' age and their number of years of experience. To analyze the associations between yam varieties and types of deterioration, a correspondence analysis was performed. This multivariate statistical method allows for a graphical representation of relationships between qualitative variables. The closer two points are on the graph, the more strongly they are associated in the data. This approach allowed for the visualization of specific deterioration patterns for each variety and the identification of their main vulnerabilities.

Results and Discussion

Sociodemographic characteristics

A total of 100 sellers across three regions were surveyed. The results (Figure 2) show that females are heavily involved in yam sales, accounting for 65% of sellers compared to 35% for males. The chi-square test performed shows a significant difference between these proportions at a threshold of 5%, with a p-value of 0.0027, which is well below 0.05. The significant involvement of women in yam marketing might be associated with cultural and socioeconomic factors. Females are more involved in sales activities, while men are more involved in agricultural production. In Burkina Faso, only 8.2% of women are individual landowners, compared to 45.5% of males, and 32% of women in unions own land (Souratié *et al.*, 2019). The study of Tiama *et al.* (2016) revealed that only one woman was involved in yam cultivation out of a total of 128 farmers surveyed. This supports our results, indicating that women are generally responsible for the marketing of tubers, whether sold raw, boiled, or in processed forms. Most of the agricultural activities are carried out by males. Yam sales should be for females, a lucrative activity that allow them to support male in their daily lives such as children's education, and family needs (Tiama *et al.*, 2016).

Our respondents were mainly adults aged between 25 and 50, with an average age of around 35-40 (Figure 3). The high frequency of ages 30, 32, 34, and 25 reflects the fact that trade is mainly carried out by adults. Indeed, trading requires a certain amount of physical activity, which mainly involves an active age group. Moreover, the social and economic pressures experienced by this population group likely contribute to their involvement in income-generating activities, such as yam trading.

Analysis of the sellers' experience shows that the majority of them have less than 20 years of experience, with a core group around 10 years (Figure 4). There are also a few highly experienced sellers, but the population remains mainly concentrated at the young and medium levels of experience. Yams sell bring income to the stakeholders, which permits them to support their families. These observations are important because they may influence commercial practices and the level of involvement of sellers in the sector.

Figure 5 shows the correlation between age and experience. Experience is positively correlated with age, meaning that older sellers generally have more years of experience in yam selling than younger ones. The older the seller, the more experience he or she tends to have.

Supplementary Figure 1 illustrates the educational levels of yam sellers, showing that respondents with no formal education (48%) and primary education (37%) constituted the majority, whereas Koranic education (7%), secondary education (7%), and higher education (1%) were less represented. Those with no schooling represent a large group and are statistically more numerous than most other categories, except for primary school, where the difference is not significant ($p=0.1526 >0.05$). In general, the predominance of low educational levels among respondents may have implications for business practices and the accessibility of technical information regarding hygiene and storage methods.

Socioeconomic characteristics

The results presented in *Supplementary Figure 2* indicate that the American yam variety (Figure 1A) was the most commonly sold (49%), followed by the Gona variety (Figure 1B) at 36%, whereas the Tila (8%), Beté (3%), Pkanpkara (2%), and Blan (2%) varieties were much less represented in the market. These differences may reflect the lower production or limited market availability of certain varieties. It is also likely that the less popular cultivars are mainly reserved for household use rather than for sale. Consumer preference for certain varieties may also contribute to their predominance on the market. In addition, the possibility of processing certain cultivars enhances their commercial appeal compared to others. These observations agree with Sory *et al.* (2021), who report that the cultivar most produced by growers is American (20.7% of producers), followed by Gona (16.2%) and Tila (13.2%). This distribution highlights the predominance of certain varieties both in production and on the market, explaining their wide availability. The yam varieties observed in the markets were

identified as *Dioscorea alata* (“America”) and *Dioscorea rotundata*–*cayenensis* (other varieties), which have also been reported as the most widely cultivated species in the study by Sory *et al.* (2021). Surveys (*Supplementary Figure 3*) reveal that the majority of yams come from local production, with significant proportions coming from Gaoua (21%), Bobo-Dioulasso (11%), Banfora (8%) and Mangodara (6%). The figures thus show that sellers mainly source their supplies from these local production areas. However, imports from neighboring countries such as Côte d'Ivoire (20%) and Ghana (10%) are also observed. This dependence on neighboring countries reflects the complementarity of markets and strong local demand, which sometimes exceeds national production capacity. It also illustrates the cross-border dimension of the yam trade, which is a key factor in food security and product availability in urban markets. As shown in *Supplementary Figure 4*, sellers primarily source their supplies from wholesalers and farmers. The figure additionally presents the storage periods, highlighting the length of time yams are stored by wholesalers and retailers prior to reaching consumers.

The proximity graph highlights the associations between yam varieties and the types of deterioration observed in the market (*Supplementary Figure 5*). The observed associations indicate that the Gona variety is mainly affected by spoilage, while the American variety is more prone to drying-related losses. Conversely, the Blanc and Pkanpkara varieties tend to undergo deterioration through softening. This differentiation highlights the need for preservation approaches tailored to the specific deterioration mechanisms of each variety.

As shown in *Supplementary Figure 6*, yam market prices varied considerably, ranging from 200 to 700 CFA francs per kilogram. This price variability may be attributed to differences in the source of tuber supply as well as the selling period, both of which influence market supply and demand dynamics. These results are slightly higher than those reported by Tiama *et al.* (2016), who observed prices on urban markets ranging from 100 F CFA/kg for *D. alata* yams to 250 F CFA/kg for *D. rotundata* yams. The yam plays an important economic role, with *Supplementary Figure 7* showing daily earnings ranging from 2000 to more than 50,000 CFA francs, depending on the species sold and if sellers are wholesalers.

Post-harvest quality of yams

Supplementary Figure 8 shows that 59% of sellers store their products in the open air at sales sites, while 41% use closed containers. Overall, these storage methods result in estimated losses of 76% due to rotting, 18% due to drying out, and 6% due to softening (*Supplementary Figure 9*). Rotting is mainly attributed to unsuitable storage conditions (49%), high temperatures (32%), and, to a lesser extent, the use of fertilizers (14%), according to the sellers surveyed (*Supplementary Figure 10*). Consistent with these findings, Tiama *et al.* (2016) reported the use of pesticides in yam cultivation and noted that tubers treated with chemical fertilizers are often preferred by consumers due to their larger size. However, such tubers tend to have a shorter shelf life and are associated with a higher risk of rapid rotting during storage. These conditions, when combined with inadequate storage practices, substantially reduce the shelf life of yams, which ranges from one to 28 weeks, as illustrated in *Supplementary Figure 11*. Despite their importance, roots and tubers, particularly yams, suffer post-harvest losses of up to 80%, mainly due to microbial deterioration, pest attacks, poor handling practices, and inadequate storage conditions. These factors severely compromise their role in local food systems and economies (Assiri *et al.*, 2017; Damtew, 2021). The results of this study reveal that the storage conditions observed may cause contamination by spoilage organisms such as *Aspergillus*, *Penicillium*, and *Fusarium*. In addition to their pathogenicity, these fungi produce various mycotoxins, including aflatoxin and ochratoxin (Esheli *et al.*, 2022). Mshelia *et al.* (2023) reported that poor post-harvest practices and storage play a key role in aflatoxin and fumonisin contamination. These substances pose a major threat to human health, such as disrupting fetal development and causing kidney disease (Zhang *et al.*, 2022; Bastos-Moreira *et al.*, 2024). In addition, certain mycotoxins, particularly aflatoxin B1, have a synergistic effect with the hepatitis B virus in the

development of liver cancer. They can also interact with HIV/AIDS and are suspected of being involved in kwashiorkor, considered a pediatric form of aflatoxicosis (Adjovi *et al.*, 2015).

Conclusions

This study highlights the critical role of storage and marketing practices in shaping both the economic outcomes of yam sellers and the quality of the tubers offered to consumers. The findings demonstrated that inadequate storage conditions and the limited use of appropriate preservation techniques contribute significantly to postharvest losses and income variability. Moreover, the influence of yam variety and the application of chemical products on shelf life underscores the need for tailored interventions to improve handling and storage methods. Strengthening sellers' knowledge and promoting better practices would not only reduce financial losses but also enhance food quality and consumer health. Ultimately, improving yam marketing systems represents a strategic pathway to supporting food security and livelihoods in Burkina Faso.

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Online supplementary material

Supplementary Figure 1. Distribution of salespeople by level of education.

Supplementary Figure 2. Varieties of yams sold in the markets surveyed. A) American; B) Gona.

Supplementary Figure 3. Source of yams sold on markets.

Supplementary Figure 4. Flow diagram.

Supplementary Figure 5. Association between yams varieties and deterioration types.

Supplementary Figure 6. Market price.

Supplementary Figure 7. Daily earning.

Supplementary Figure 8. Storage conditions.

Supplementary Figure 9. Loss reasons.

Supplementary Figure 10. Spoilage reasons.

Supplementary Figure 11. Duration of conservation.

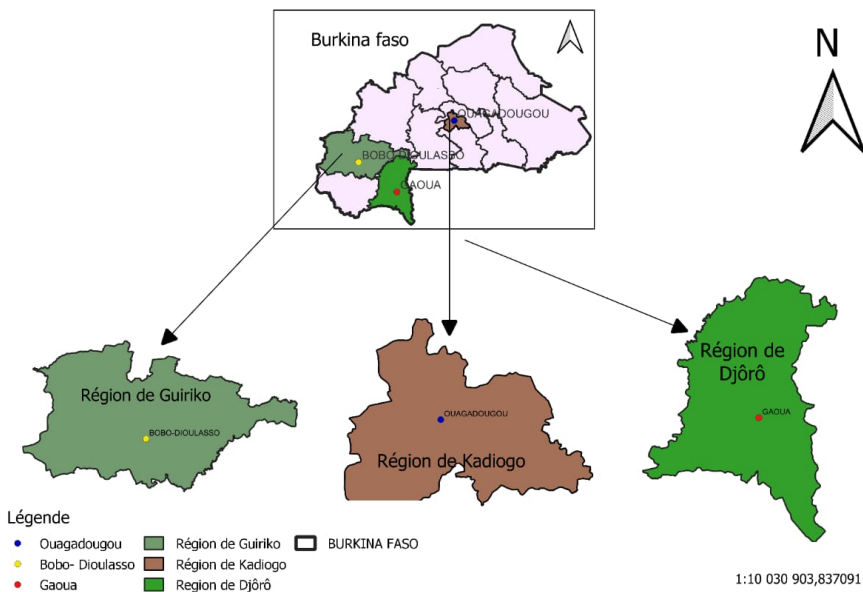


Figure 1. Study area.

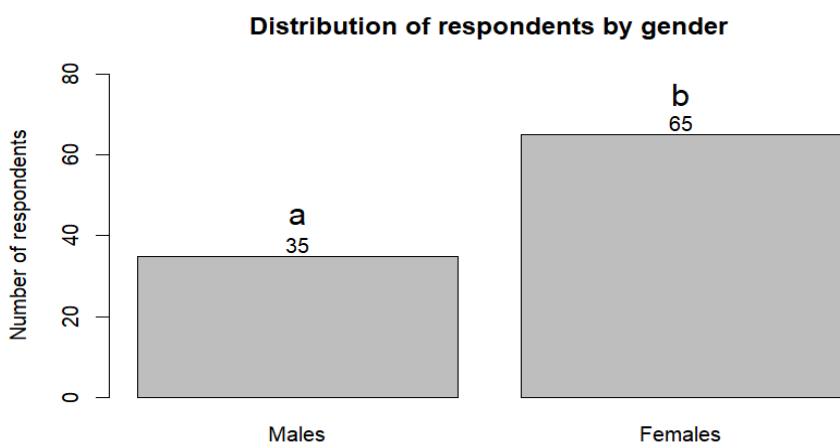


Figure 2. Distribution of sellers surveyed by gender.

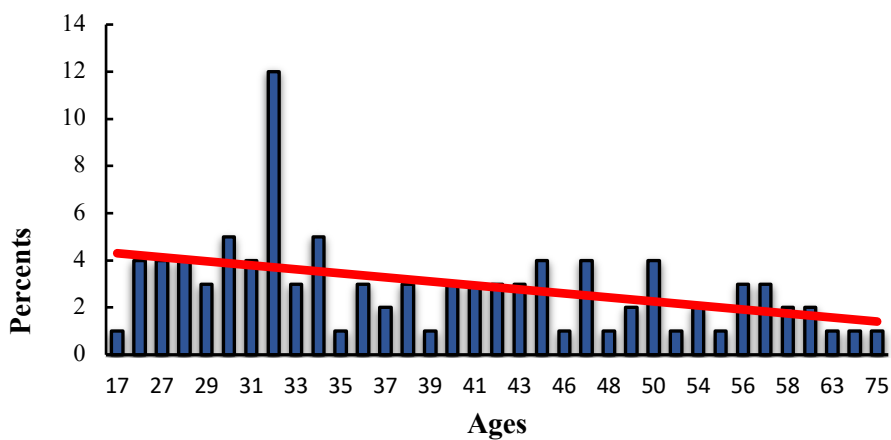


Figure 3. Distribution of Yam sellers by age group.

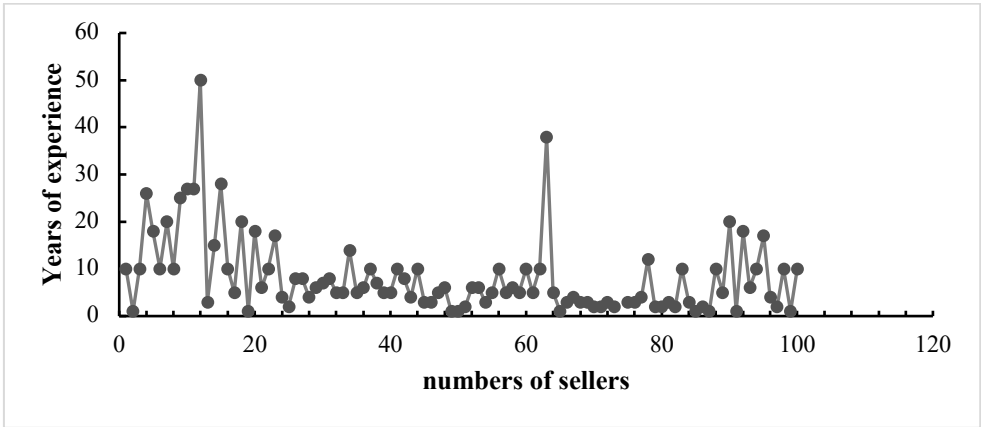


Figure 4. Distribution of sellers by experience.

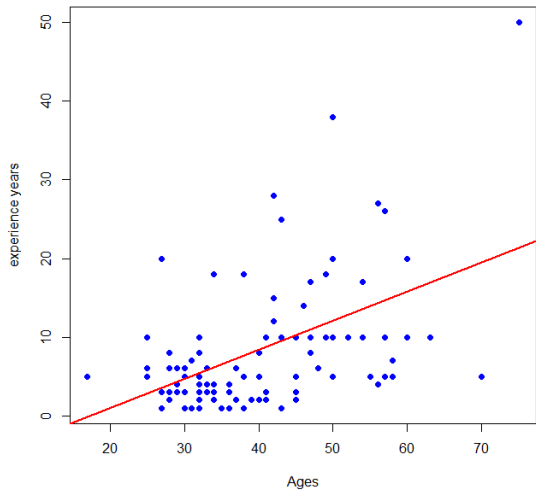


Figure 5. Correlation between age and experience.