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Case Study of Post-Harvest Processing and Value Addition in Fresh-Eating Sweet Potato

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Abstract This study explores the impact of post-harvest processing and value-added methods for fresh sweet potatoes on farmers' income and market demand. The research finds that value-added processing of sweet potatoes, such as producing sweet potato flour, chips, and puree, helps increase farmers' income, reduce post-harvest losses, and extend product shelf life. Additionally, farmer cooperatives and agricultural groups play a significant role in promoting value-added activities by providing training, technical support, and market access. The study recommends further promotion of value-added processing technologies, improved credit access for smallholders, and the establishment of better market linkages through government and non-governmental organizations to enhance the market value of sweet potato products and boost farmers' economic returns.
Keywords Fresh sweet potato; Post-harvest processing; Value-added processing; Farmers' income; Market demand

1 Introduction

Sweet potatoes (*Ipomoea batatas*) are a globally significant crop, valued for their nutritional benefits and versatility in culinary applications. Particularly in regions like sub-Saharan Africa and Asia, sweet potatoes play a crucial role in food security due to their high yield potential and adaptability to various climates. In recent years, there has been growing interest in enhancing the post-harvest processing and value addition of fresh-eating sweet potatoes to improve marketability, reduce post-harvest losses, and create economic opportunities for farmers. The development of innovative post-harvest techniques and the promotion of value-added products have become focal points in agribusiness to improve the profitability and sustainability of sweet potato production (Sugri et al., 2019; Simões et al., 2020).

Sweet potatoes are prone to significant post-harvest losses, particularly due to their perishable nature. Issues such as weight loss, decay, and sprouting during storage severely affect the marketable quality and shelf life of the crop. Moreover, traditional processing methods, such as boiling and frying, often lead to nutrient loss, further reducing the product's value. Addressing these challenges through improved post-harvest techniques and exploring new value addition pathways is critical for enhancing the sweet potato's contribution to food security and income generation. Post-harvest processing methods, such as drying, minimal processing, and storage innovations, play a pivotal role in maintaining the quality and prolonging the shelf life of sweet potatoes. Value addition, through the creation of products like sweet potato flour, chips, and puree, can increase the economic returns for smallholder farmers, as demonstrated by studies in regions such as Nigeria and South Africa (Adeyonu et al., 2017; Ejechi, 2023). Moreover, research indicates that delaying harvest can induce the production of beneficial bioactive compounds, enhancing the nutritional value of minimally processed sweet potatoes (Simões et al., 2020). These advances underscore the importance of strategic post-harvest interventions to ensure both nutritional preservation and economic viability.

This study explores post-harvest processing techniques and value-adding opportunities for fresh sweet potatoes, evaluating the effectiveness of various treatments in extending shelf life and improving quality, while also investigating scalable value-adding opportunities for smallholder farmers to enhance their income and market

access. It further analyzes factors influencing both producers' and consumers' adoption of value-added sweet potato products, aiming to guide research on optimizing post-harvest practices and value addition, ultimately benefiting local economies and the global food system.

2 Economic and Nutritional Value of Sweet Potatoes

Sweet potatoes (*Ipomoea batatas*) are not only a staple food in many regions of the world but also an economically valuable crop due to their adaptability and nutrient-rich composition. Their economic and nutritional importance has gained attention, especially in regions striving to improve food security and income generation through agricultural diversification. Sweet potatoes are a versatile crop, used both as a food product and for industrial applications, with various processing options enhancing their value.

2.1 Nutritional composition of sweet potatoes

Sweet potatoes are a nutrient-dense food that provides significant health benefits. They are particularly high in carbohydrates, dietary fiber, and vitamins, notably vitamin A (as beta-carotene), vitamin C, and essential minerals such as potassium, magnesium, and iron. The different flesh colors of sweet potatoes-orange, purple, and white-correlate with varying levels of nutrients. For instance, orange-fleshed sweet potatoes are rich in beta-carotene, while purple varieties have higher levels of anthocyanins, known for their antioxidant properties. Studies have shown that sweet potatoes also provide bioactive compounds that contribute to anti-inflammatory, anti-cancer, and anti-diabetic effects (Alam, 2021). Furthermore, the bioavailability of these nutrients can vary with processing methods such as boiling, roasting, and frying, with roasted sweet potatoes retaining the highest nutritional value in terms of vitamins and phenolic content (Yvonne and Pontsho, 2023).

2.2 Importance of sweet potatoes as a food security crop

Sweet potatoes play a critical role in global food security, especially in regions with limited access to other staple crops. Their ability to grow in diverse climatic conditions, including regions with poor soils and minimal inputs, makes them a resilient crop in the fight against hunger. Sweet potatoes, particularly the orange-fleshed varieties, are recognized for their potential to alleviate vitamin A deficiency in developing countries (Sanoussi et al., 2016). Moreover, their short growing season and relatively low labor requirements allow for multiple harvests per year, contributing to continuous food supply and income generation for smallholder farmers (Sugri et al., 2017). Additionally, sweet potatoes can be processed into various value-added products like flour, chips, and purees, which further enhances their economic and nutritional contributions to food security.

Motsa et al. (2015) highlights the resilience of sweet potatoes as a drought-tolerant crop and its role in ensuring food security, especially in regions prone to climate change. It underscores how sweet potatoes thrive in poor soils and with minimal inputs, making them a critical crop for food security in developing countries (Motsa et al., 2015). The study investigates how the market behavior of sweet potatoes impacts food security. It discusses the market potential of new varieties with high beta-carotene and anthocyanins, and their significance in addressing nutritional deficiencies while supporting food security, particularly in the context of developing markets (Rozi et al., 2021).

2.3 Consumption patterns of sweet potatoes in different countries

The consumption patterns of sweet potatoes vary widely across different regions, reflecting cultural preferences, economic factors, and availability. In sub-Saharan Africa, sweet potatoes are a staple food, consumed in both fresh and processed forms. In contrast, in industrialized nations such as Japan and the United States, sweet potatoes are often consumed as a health food due to their rich nutritional profile and are increasingly used in processed products such as snacks and baked goods (Hou et al., 2019). In countries like Indonesia and China, sweet potatoes are also used in traditional dishes, with a growing interest in their health benefits driving higher consumption (Kurnianingsih et al., 2020). Overall, sweet potatoes are increasingly being recognized not just as a staple food but also as a functional food with significant health benefits.

Galvao et al. (2021) highlights the growing demand for sweet potatoes in Europe and provides insights into the nutritional content of different sweet potato accessions, focusing on their potential contribution to improving the

human diet, particularly in markets where sweet potato consumption is not widespread (Galvao et al., 2021). The study investigates the consumption behavior of sweet potato consumers in Beijing, China, and analyzes how different market segments prioritize sweet potato products based on factors like nutritional value, taste, and convenience. It provides an in-depth look at the growing interest in sweet potatoes as a functional food in urban China (Zhang et al., 2018).

3 Post-Harvest Processing Techniques for Sweet Potatoes

Post-harvest processing of sweet potatoes plays a crucial role in maintaining their quality, extending shelf life, and enhancing their economic value. Various techniques, including grading, cleaning, drying, and storage, have been developed to minimize post-harvest losses and ensure the best quality for consumption or further processing (Fang, 2024a).

3.1 Grading, cleaning, and peeling of sweet potatoes

Grading and cleaning are essential initial steps in the post-harvest processing of sweet potatoes. These processes help remove dirt, debris, and inferior quality produce, ensuring that only high-quality roots are further processed. Cleaning techniques may vary from simple water rinses to more sophisticated washing systems that reduce microbial contamination. Automated systems for cleaning and grading sweet potatoes are being increasingly adopted to enhance efficiency and reduce labor costs (Abbasov, 2019).

Peeling is another important step in preparing sweet potatoes for consumption or industrial processing. Mechanical peeling methods, such as abrasion peeling, are commonly used in large-scale processing plants. These methods help to efficiently remove the skin without causing significant damage to the tuber, which can help maintain the nutritional content and minimize waste (Rashid et al., 2022). Peeling is particularly important in ready-to-eat and processed products where the outer skin is less desirable for consumers.

3.2 Drying, storage, and processing methods

Drying is a widely used post-harvest method to extend the shelf life of sweet potatoes by reducing their moisture content. Various drying methods are employed, including sun drying, hot-air drying, and advanced techniques like vacuum and freeze drying. Sun drying, although cost-effective, is prone to contamination and nutrient loss. In contrast, advanced drying technologies such as freeze-drying and vacuum drying help retain more nutrients, such as beta-carotene and phenolic compounds, improving the nutritional value of the final product (Savas, 2022).

Storage conditions play a critical role in maintaining the quality of sweet potatoes. Proper storage helps to minimize physiological weight loss, sprouting, and microbial decay. Techniques such as the use of ventilated storage bags and improved traditional platforms have shown positive results in reducing spoilage, particularly under challenging storage conditions in tropical climates (Richard et al., 2023). Studies show that the combination of infrared drying (IR) and hot air drying (HAD) can significantly reduce drying time, lower energy consumption, and maintain the integrity of the product's color and microstructure (Figure 1) (Rashid et al., 2022). The use of curing before storage-where harvested sweet potatoes are exposed to high humidity and moderate temperatures-helps to heal minor wounds, reducing post-harvest decay and enhancing storability (Sugri et al., 2019).

3.3 Effects of storage conditions on sweet potato quality (e.g., sugar and starch content)

Storage conditions significantly affect the quality of sweet potatoes, particularly their sugar and starch content. During storage, enzymatic activities cause changes in the starch and sugar levels. Under improper storage conditions, sweet potatoes can experience rapid starch degradation, leading to an increase in sugar content. This change impacts the texture and flavor, making the sweet potatoes sweeter and softer (Kwarteng et al., 2020).

Research has shown that prolonged storage at optimal temperatures (around 13-15°C) can maintain the balance between starch and sugar, preserving the overall quality of the tubers. Additionally, delayed harvesting has been found to induce the accumulation of bioactive compounds, such as carotenoids, which enhance the nutritional value of the sweet potatoes (Simões et al., 2020). However, excessively long storage or improper temperature control can lead to undesirable texture changes and nutrient loss.

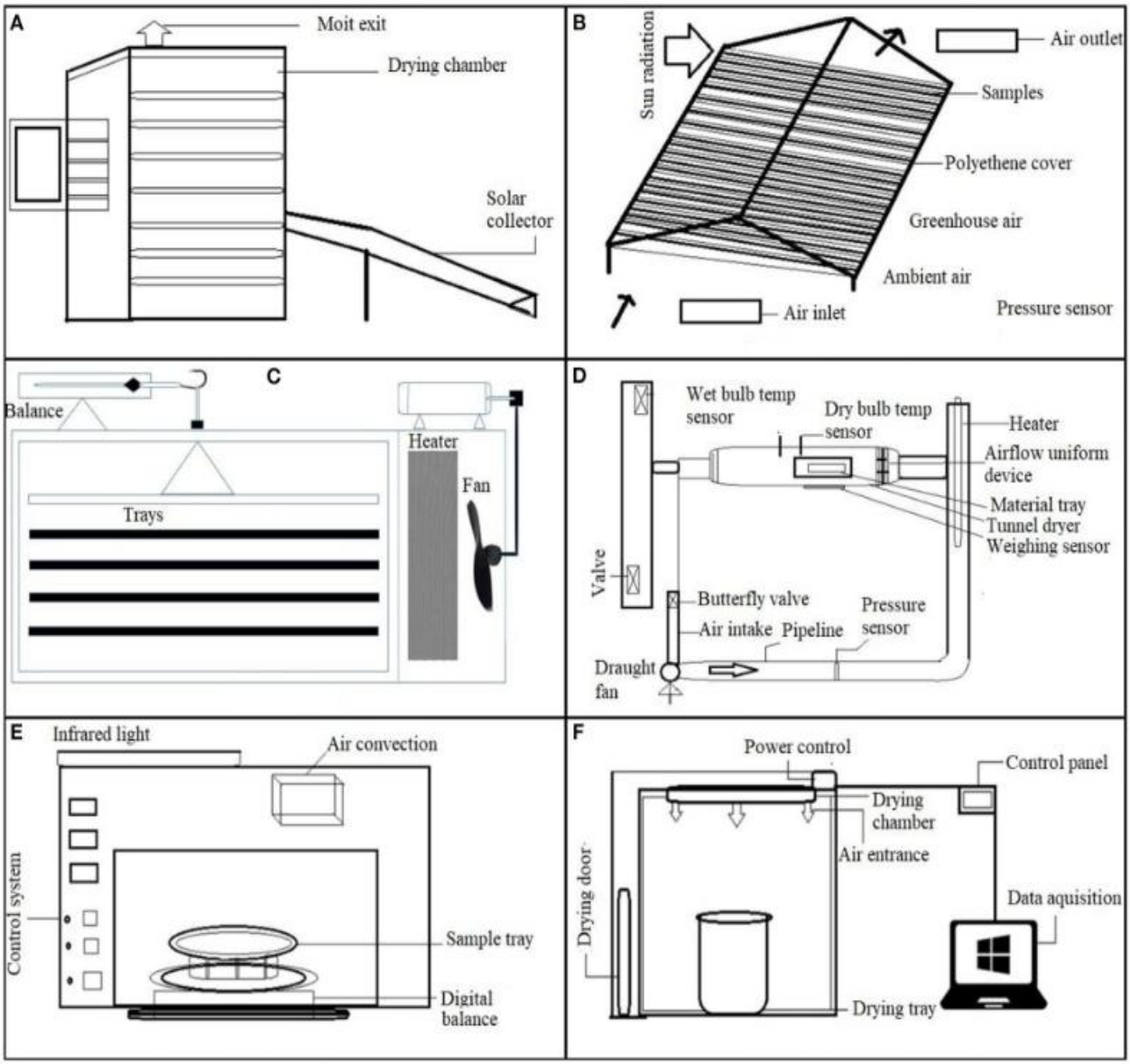

Figure 1 Comparison of energy efficiency in different sweet potato drying methods (Adopted from Rashid et al., 2022)

4 Value-Addition Processing Methods for Sweet Potatoes

Value addition in sweet potato processing involves transforming the raw crop into various products to improve its marketability, shelf life, and economic value. Different forms of processing methods have emerged, enhancing the utilization of sweet potatoes for both small-scale farmers and industrial applications.

4.1 Forms of processing (e.g., sweet potato flour, chips, puree)

Sweet potatoes can be processed into various forms such as flour, chips, puree, and starch, which not only increase their shelf life but also create more versatile uses for the crop. Sweet potato flour, for example, is widely used in baking as a gluten-free alternative. Chips and fries are popular snack products, while puree is used in baby food and as a base ingredient in many culinary products. Processing sweet potatoes into these forms helps reduce post-harvest losses and makes it easier to transport and store the crop, contributing to increased income for farmers and producers (Alalade et al., 2019). The study results indicate that temperature significantly affects shrinkage rates, which increase with prolonged drying time. Additionally, the images provide a visual representation of the shape changes in SP samples after 200 minutes of drying (Figure 2) (Gonçalves et al., 2023). Studies show that transforming sweet potatoes into products such as chips, flour, and puree can significantly increase farm income and reduce food waste in rural communities (Ejechi, 2023; Orinda et al., 2017).

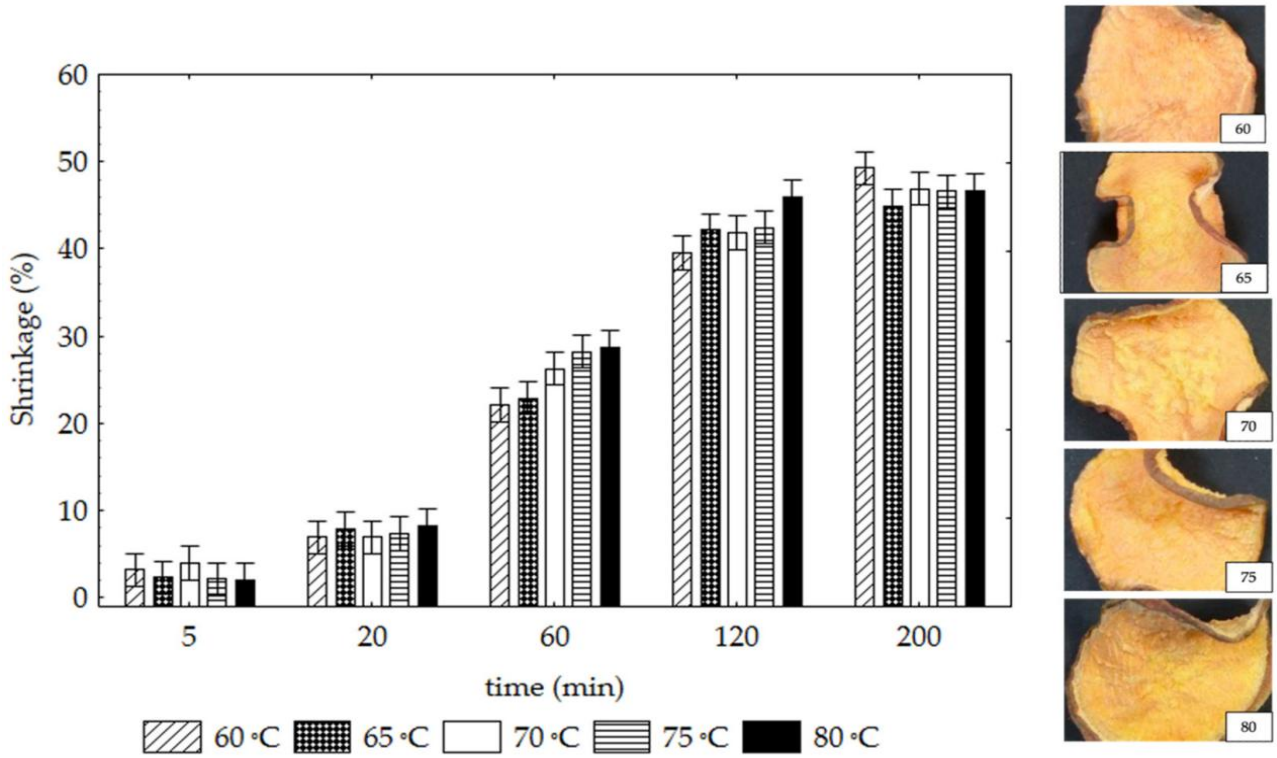

Figure 2 The variations in sample shrinkage rates under different drying temperature conditions (Adopted from Gonçalves et al., 2023)

4.2 Factors affecting quality during processing (e.g., storage time, temperature)

The quality of sweet potato products can be influenced by several factors during processing, including storage conditions, temperature, and processing techniques. For instance, prolonged storage or high storage temperatures can degrade the nutritional quality of sweet potatoes by reducing their starch content and increasing sugar levels. High temperatures used during drying or frying can also affect the retention of important nutrients like beta-carotene, which is sensitive to heat. Techniques like sun-drying are cost-effective but may result in lower nutrient retention compared to vacuum or freeze-drying methods, which are more efficient at preserving vitamins and antioxidants (Figure 3) (Rashid et al., 2022).

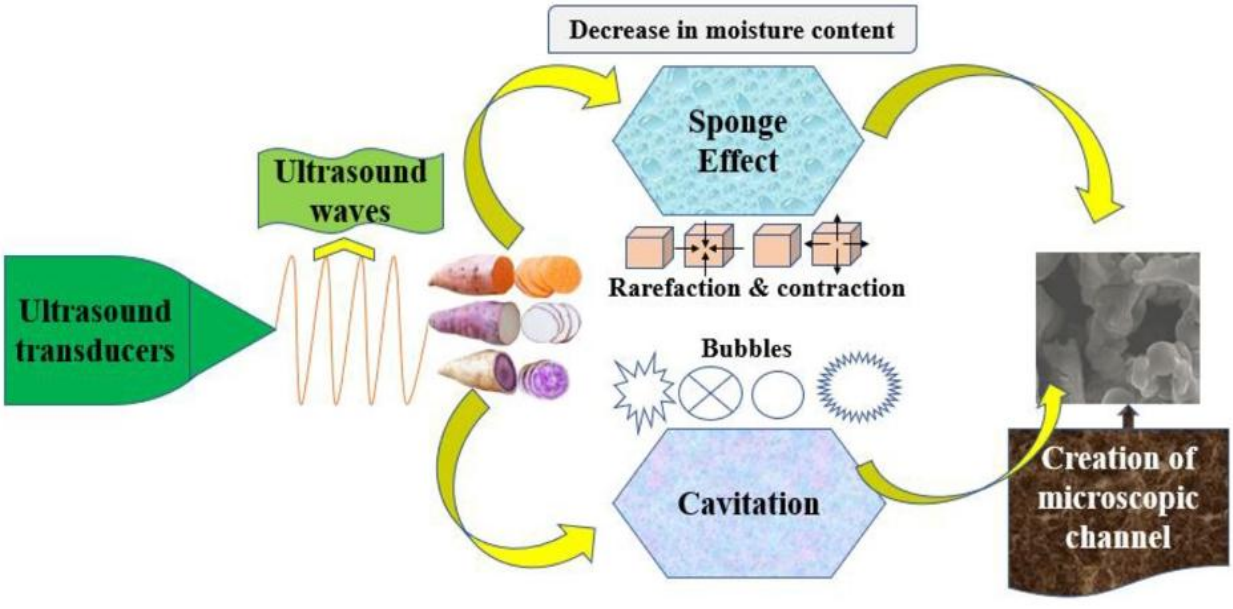

Figure 3 The impact of ultrasound technology on the drying process of sweet potato samples (Adapted from Rashid et al., 2022)

Storage time before processing is critical in maintaining the quality of sweet potatoes. Longer storage durations can lead to sprouting or microbial spoilage, reducing the final quality of the processed products. Additionally, the duration and method of cooking or drying sweet potatoes, such as roasting or boiling, can also significantly impact the texture, flavor, and nutritional value of the final product (Yvonne and Pontsho, 2023).

4.3 Impact of technological improvements on value addition (e.g., mechanical harvesting and slicing machines)

Technological advancements have greatly improved the efficiency of sweet potato processing, especially for smallholder farmers. Mechanical harvesting tools and slicing machines reduce labor costs and time, allowing for faster and more uniform processing of sweet potatoes. These technologies help streamline the production of value-added products such as chips and flour, which require precise cutting and drying (Fatmala, 2021).

Moreover, improvements in drying technologies, such as vacuum drying and the use of ultrasound-assisted osmotic dehydration, have enhanced the ability to preserve nutrients and maintain the quality of sweet potato products. These methods improve the efficiency of processing by reducing drying times and retaining higher levels of antioxidants and vitamins, which would otherwise degrade under traditional methods (Oladejo and Ma, 2016). The adoption of mechanical processing equipment has been shown to significantly improve the profitability of sweet potato products, making it easier for farmers to enter larger markets (Oluoch et al., 2016).

5 Impact of Sweet Potato Value Addition on Farmers' Income

Value addition in agriculture, particularly for sweet potato farming, is a transformative approach that helps farmers boost their income, improve market access, and increase the overall economic value of their produce. Through value-added processing, farmers can transform raw sweet potatoes into a variety of products such as flour, chips, and puree, significantly increasing their earning potential. This section explores the substantial impact of value addition on farmers' income, with a focus on the role of cooperatives and market access in enhancing profitability (Fang, 2024b).

5.1 Contribution of value-added processing to farmers' earnings

Value addition in agriculture, particularly for sweet potato farming, is a transformative approach that helps farmers boost their income, improve market access, and increase the overall economic value of their produce. Through value-added processing, farmers can transform raw sweet potatoes into a variety of products such as flour, chips, and puree, significantly increasing their earning potential. This section explores the substantial impact of value addition on farmers' income, with a focus on the role of cooperatives and market access in enhancing profitability (Sugri et al., 2017; Fatmala, 2021).

The income earned from processed products is also more stable compared to that from raw sweet potatoes, which are more susceptible to price fluctuations. In Kenya's Homa Bay County, farmers who added value to their sweet potato crops through processing observed a steady increase in their income due to the high demand for processed products like chips and flour (Oluoch et al., 2016). The steady income provided by value addition also allows farmers to reinvest in their farms, improve their living conditions, and secure better education for their children. Value addition not only enhances income but also reduces post-harvest losses, which is crucial for regions with limited access to storage and transport facilities.

5.2 Role of agricultural cooperatives and farmer groups in value addition

Agricultural cooperatives and farmer groups play a crucial role in the success of value addition for smallholder farmers. These groups offer collective support in terms of training, resource pooling, access to technology, and market connections, making it easier for farmers to adopt value-added practices. For many smallholder farmers, joining cooperatives provides them with the infrastructure needed to process sweet potatoes and the knowledge required to implement value addition techniques effectively. For instance, in Ebonyi State, Nigeria, research indicated that membership in farmer associations significantly increased the likelihood of farmers engaging in value-added activities, such as drying or converting sweet potatoes into flour and chips (Ejechi, 2023). These cooperatives enable members to access credit, which is crucial for investing in processing equipment, packaging materials, and transportation.

Cooperatives also facilitate collective marketing efforts, which help smallholder farmers negotiate better prices for their processed goods. In Kenya, farmer groups were shown to have a stronger bargaining power in markets compared to individual farmers, enabling them to secure better deals and more consistent buyers for their value-added products (Orinda et al., 2017). Additionally, cooperatives often provide essential training in business management and quality control, ensuring that farmers can maintain high standards for their products, which further enhances their market competitiveness. By working together, farmers in cooperatives can overcome many of the barriers that traditionally prevent smallholders from entering larger, more lucrative markets.

5.3 Market access and price influence

Market access is one of the most significant factors determining the success of value-added sweet potato products. Farmers who are able to reach broader markets, whether through direct sales, contracts with retailers, or cooperative marketing channels, are more likely to see substantial income growth from their value-added products. In Uganda, for example, smallholder farmers who participated in value addition through potato processing experienced a 25% increase in income compared to those selling raw tubers. Market access was particularly enhanced for farmers who had contracts with buyers or worked through farmer groups, which provided a stable and predictable demand for their products (Sebatta et al., 2015).

Price influence also plays a critical role in determining the profitability of value-added products. When farmers are able to access urban markets or international markets, where the demand for processed food is higher, they can command better prices for their products. In Ghana, a study on the sweet potato value chain showed that linking farmers to more stable market channels, such as supermarkets and processors, reduced price volatility and improved overall market efficiency (Sugri et al., 2017). Furthermore, collective marketing efforts through cooperatives or associations can help stabilize prices by reducing competition among smallholder farmers and increasing their negotiating power.

Additionally, farmers who participate in value addition often benefit from price premiums for processed goods, as these products tend to offer better convenience and longer shelf life to consumers. The development of market infrastructure, such as processing facilities and storage systems, further supports farmers in accessing higher-value markets. Therefore, the combination of value addition, cooperative support, and improved market access plays a pivotal role in enhancing farmers' income and ensuring the sustainability of sweet potato farming.

6 Case Study: Post-Harvest Processing and Value Addition in Fresh-Eating Sweet Potatoes

Post-harvest processing and value addition are essential for improving the economic and nutritional value of sweet potatoes. This case study focuses on specific methods and outcomes of implementing post-harvest processing techniques to enhance the marketability of fresh-eating sweet potatoes. By exploring real-world practices and analyzing the effectiveness of these techniques, the case study highlights the potential for improving smallholder farmers' livelihoods.

6.1 Study location and methods

Adeyonu et al. (2017) was conducted in Offa and Oyun local government areas of Kwara State, Nigeria, two regions known for sweet potato production. The areas are characterized by favorable climatic conditions that support sweet potato farming year-round. The study employed a multi-stage sampling technique to select 163 smallholder sweet potato farmers. Data collection involved the use of structured questionnaires, participant observations, and interviews to gather insights into the post-harvest processes and value addition activities undertaken by these farmers (Adeyonu et al., 2017).

The farmers were selected based on their participation in sweet potato farming and processing activities. The research aimed to evaluate how value addition through processes like drying, peeling, and frying influenced their income and overall production efficiency. Additionally, focus group discussions were held with farmers to identify challenges and opportunities in the value addition process. The data collected were analyzed using descriptive statistics and the Heckman two-stage model to evaluate the determinants of value addition in sweet potato farming.

6.2 Implementation of processing techniques

In the study areas, farmers employed various post-harvest processing techniques to add value to their sweet potatoes. The most common activities included slicing and sun-drying, with 44% of respondents involved in these processes. Sun-drying is a cost-effective method, though it is subject to contamination risks. Another 39% of farmers engaged in more advanced techniques, combining slicing, drying, and grinding to produce sweet potato flour. This flour is sold in local markets and used in the production of snacks and baked goods, offering an extended shelf life and reducing post-harvest losses.

Additionally, 15% of the farmers focused on frying sweet potatoes to produce chips, a popular snack in both rural and urban markets. Frying significantly increases the value of sweet potatoes, making them more profitable than selling raw tubers. The study found that farmers who were trained in processing techniques and received support from agricultural extension services were more likely to engage in these value-adding activities. Moreover, access to credit and membership in farmer cooperatives were significant factors in determining the extent of value addition (Adeyonu et al., 2017).

6.3 Processed product types and market demand

The processed products generated through value addition included sweet potato flour, chips, and puree, each catering to different market demands. Sweet potato flour is highly sought after in both local and urban markets due to its versatility and use in baking. The demand for gluten-free products has driven the popularity of sweet potato flour, particularly in health-conscious consumer segments. Sweet potato chips are another value-added product that enjoys high demand in urban centers where snacks and convenience foods are popular. These products not only increase market reach but also offer higher profit margins for farmers (Rashid et al., 2022).

In addition to these products, some farmers in the study areas produced sweet potato puree, which is used in baby food, sauces, and bakery products. Puree production requires more advanced processing techniques but offers an extended shelf life and higher market value. The increasing awareness of the health benefits of sweet potatoes, particularly the orange-fleshed variety rich in beta-carotene, has driven demand for these processed products.

The study found that market demand for processed sweet potato products was influenced by several factors, including product quality, packaging, and marketing strategies. Farmers who invested in better packaging and participated in cooperative marketing initiatives experienced higher sales and greater access to urban markets. Overall, value addition has the potential to significantly improve farmers' income and enhance the marketability of sweet potatoes in both local and regional markets (Oluoch et al., 2016).

7 Concluding Remarks

The case study of post-harvest processing and value addition in fresh-eating sweet potatoes highlights the significant impact that these processes have on improving both the quality and economic value of sweet potatoes. Through the adoption of value-adding techniques, farmers can reduce post-harvest losses, extend the shelf life of their produce, and access better markets. The study reveals that both small-scale and large-scale processing of sweet potatoes contribute to enhanced incomes for farmers and greater market penetration for sweet potato-based products. However, there are still challenges that need to be addressed, particularly in terms of training, technological advancements, and market access.

Post-harvest processing techniques such as drying, frying, and grinding into flour have a profound impact on the profitability of sweet potato farming. Farmers who adopt value-adding practices experience higher income due to the increased market value of processed products like chips, flour, and puree. The study also emphasizes the role of cooperatives and farmer groups in promoting value addition. Farmers who are part of these groups are more likely to receive training and financial support, enabling them to engage in value-added processing and access more lucrative markets. Moreover, factors such as storage time, temperature, and processing methods were found to be critical in maintaining the quality of sweet potatoes during and after processing. The study also highlights that farmers who invested in technologies such as mechanical slicers and dryers experienced more efficiency in their operations and increased product quality. These technological advancements not only enhance the

profitability of sweet potato farming but also improve the nutritional value of processed products by preserving key nutrients like beta-carotene and vitamin C.

To further promote value addition in sweet potato farming, several recommendations arise from the study. It is essential for governments and agricultural development programs to increase their efforts in providing training and education to farmers on value-added processing techniques. This can be achieved through the expansion of extension services and the promotion of farmer cooperatives, which have proven to be effective in disseminating knowledge and resources.

Access to credit should be improved for smallholder farmers to enable them to invest in processing technologies. Investments in equipment such as dryers, grinders, and packaging materials are necessary to ensure that farmers can produce high-quality processed products that meet market demands. In addition, governmental and non-governmental organizations should focus on establishing proper market linkages for processed sweet potato products, ensuring that farmers can sell their products at competitive prices. Research and development should continue to focus on improving the efficiency of post-harvest processing technologies. Innovations in drying and storage techniques, as well as advances in mechanical processing equipment, can significantly improve the shelf life and nutritional value of sweet potatoes. These improvements will be crucial in expanding the market reach of sweet potato products and enhancing the livelihoods of farmers engaged in value addition.

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Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

Reference

Abbasov G.I., 2019, Research of technological process of harvesting and post-harvest processing of potatoes, Agrarian Science, 6: 33-35.
https://doi.org/10.32634/0869-8155-2019-329-6-33-35

Adeyonu A., Ajala A., Adigun G., Ajiboye B., and Gbotosho O., 2017, Determinants of sweet potato value addition among smallholder farming households in Kwara state, Nigeria, Agro-Science, 15(1): 17-22.
https://doi.org/10.4314/AS.V15I1.4

Alalade O.A., Oladunni O., Adisa R.S., Olayode O.O., and Paul A.B., 2019, Effect of value addition on farm income of sweet potato-based farmers in Kwara State, Nigeria, Journal of Agricultural Extension, 23(4): 92-98.
https://doi.org/10.4314/jae.v23i4.11

Alam M.K., 2021, A comprehensive review of sweet potato (*Ipomoea batatas* [L.] Lam): revisiting the associated health benefits, Trends in Food Science & Technology, 115: 512-529.
https://doi.org/10.1016/J.TIFS.2021.07.001

Ejechi M.E., 2023, Determinants of value addition among smallholder sweet potato farming households in Ebonyi State, Nigeria, FUDMA Journal of Agriculture and Agricultural Technology, 9(3): 105-112.
https://doi.org/10.33003/jaat.2023.0903.16

Fang J., 2024a, Breeding 3.0: The precise revolution of genotype selection, Molecular Plant Breeding, 15(1): 8-14.
https://doi.org/10.5376/mpb.2024.15.0002

Fang J., 2024b, Breeding 4.0: The breeding revolution of genetic information integration and editing, Molecular Plant Breeding, 15(1): 15-26.
https://doi.org/10.5376/mpb.2024.15.0003

Fatmala E., 2021, Return cost and value-added analysis of sweet potato processing (case study: Pasar Bengkel village, Perbaungan district, Serdang Bedagai regency), Agripreneur: Jurnal Pertanian Agribisnis, 10(2): 68-73.
https://doi.org/10.35335/agripreneur.v10i2.1953

Galvao A., Nicoletto C., Zanin G., Vargas P., and Sambo P., 2021, Nutraceutical content and daily value contribution of sweet potato accessions for the European market, Horticulturae, 7(2): 23.
https://doi.org/10.3390/HORTICULTURAE7020023

Gonçalves E., Pereira N., Silva M., Alvarenga N., Ramos A., Alegria C., and Abreu M., 2023, Influence of air-drying conditions on quality, bioactive composition and sensorial attributes of sweet potato chips, Foods, 12(6): 1198.
https://doi.org/10.3390/foods12061198

Hou F., Mu T., Ma M., Blecker C., and Sun H., 2019, Cultivar selection as a tool for nutritional and functional value enhancement of roasted sweet potato, Journal of Food Processing and Preservation, 43(11): e14200.
https://doi.org/10.1111/jfpp.14200

Kurnianingsih N., Ratnawati R., Nazwar T.A., Ali M., and Fatchiyah F., 2020, A comparative study on nutritional value of purple sweet potatoes from West Java and Central Java, Indonesia, Journal of Physics: Conference Series, 1665(1): 012011.
https://doi.org/10.1088/1742-6596/1665/1/012011

Kwarteng E., Oduro I., Ellis W., and Agbenorhevi J., 2020, Rapid assessment of compositional stability in improved sweet potato varieties: relevance in breeding and utilization, The International Journal of Innovative Research and Development, 9(7): 72-78.
https://doi.org/10.24940/ijird/2020/v9/i7/153749-379071-1-sm

Motsa N., Modi A., and Mabhaudhi T., 2015, Sweet potato (*Ipomoea batatas* L.) as a drought-tolerant and food security crop, South African Journal of Science, 111(11-12): 1-8.
https://doi.org/10.17159/SAJS.2015/20140252

Oladejo A., and Ma H., 2016, Optimisation of ultrasound-assisted osmotic dehydration of sweet potato (*Ipomea batatas*) using response surface methodology, Journal of the Science of Food and Agriculture, 96(11): 3688-3693.
https://doi.org/10.1002/jsfa.7552

Oluoch A., Lagat J., and Langat J., 2016, Evaluation of effects of value addition in sweet potatoes on farm income in Homa Bay County, Kenya, Journal of Economics and Sustainable Development, 7(20): 1-4.

Orinda M., Lagat J., and Mshenga P., 2017, Analysis of the determinants of sweet potato value addition by smallholder farmers in Kenya, Journal of Economics and Sustainable Development, 8(8): 1-11.

Rashid M.T., Liu K., Jatoi M.A., Safdar B., Lv D., and Li Q., 2022, Energy efficient drying technologies for sweet potatoes: operating and drying mechanism, quality-related attributes, Frontiers in Nutrition, 9: 1040314.
https://doi.org/10.3389/fnut.2022.1040314

Richard K.J., Silayo V., and Mrema G., 2023, Performance evaluation of different storage technologies on storage stability of white-coloured sweet potato roots under farmers' conditions in Tanzania, East African Journal of Agriculture and Biotechnology, 6(1): 369-377.
https://doi.org/10.37284/eajab.6.1.1473

Rozi F., Prasetiaswati N., and Elisabeth D.A.A., 2021, Study on sweet potato market behaviour in supporting food security, In: IOP Conference Series: Earth and Environmental Science, IOP Publishing, 756(1): 012082.
https://doi.org/10.1088/1755-1315/756/1/012082

Sanoussi A., Dansi A., Ahissou H., Adebowale A., Sanni L., Orobiyi A., Dansi M., and Sanni A., 2016, Possibilities of sweet potato (*Ipomoea batatas*) value chain upgrading as revealed by physico-chemical composition of ten elites landraces of Benin, African Journal of Biotechnology, 15(13): 481-489.
https://doi.org/10.5897/AJB2015.15107

Savas E., 2022, The modelling of convective drying variables' effects on the functional properties of sliced sweet potatoes, Foods, 11(5): 741.
https://doi.org/10.3390/foods11050741

Sebatta C., Mugisha J., Katungi E., Kasharu A., and Kyomugisha H., 2015, Adding value at the farm: The case of smallholder potato farmers in the highlands of Uganda, Asian Journal of Agricultural Extension, Economics & Sociology, 4(3): 210-223.
https://doi.org/10.9734/AJAEES/2015/13844

Simões A.N., Almeida S.L. de Borges C.V., Fonseca K.S., Barros Júnior A.P., de Albuquerque J.R., Corrêa C.R., Minatel I.O., Morais M.A., Diamante M.S., and Lima G.P., 2020, Delaying the harvest induces bioactive compounds and maintains the quality of sweet potatoes, Journal of Food Biochemistry, 44(8): e13322.
https://doi.org/10.1111/jfbc.13322

Sugri I., Maalekuu B., Gaveh E., and Kusi F., 2017, Sweet potato value chain analysis reveals opportunities for increased income and food security in Northern Ghana, Advances in Agriculture, 2017(1): 8767340.
https://doi.org/10.1155/2017/8767340

Sugri I., Maalekuu B., Gaveh E., and Kusi F., 2019, Compositional and shelf-life indices of sweet potato are significantly improved by pre-harvest dehaulming, Annals of Agricultural Sciences, 64(1): 113-120.
https://doi.org/10.1016/J.AOAS.2019.03.002

Yvonne M., and Pontsho T., 2023, Responses of the nutritional value of the orange fleshed 'Bophelo' sweet potato (*Ipomoea batatas* L.) cultivar under various processing techniques, Research on Crops, 24(1): 139-148.
https://doi.org/10.31830/2348-7542.2023.roc-11152

Zhang L., Liu R., and Lei S., 2018, Study on demand characteristics and market segmentation of sweet potatoes in Beijing urban area, In: International Conference on Economic Management and Green Development (ICEMGD 2018), Atlantis Press, pp.143-147.
https://doi.org/10.2991/ICEMGD-18.2018.24