

Processing and Packaging of Bamboo Shoots (Malewa) in Bugisu Region, Eastern Uganda.

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ABSTRACT: Bamboo shoot vegetable also known as 'Malewa' is an organic food delicacy among the Bamasaba people in Eastern Uganda. It is obtained from young bamboo shoots which grow naturally from forests. It can be sold as a fresh or preserved food delicacy to generate income for the people. Apart from being a delicacy, Malewa has several nutritional food values that can make it a high-value health food product through appropriate processing and marketing. However, the methods used to process, package, and position it as a high-value organic food in the market are still wanting. The purpose of this conceptual paper is to discuss the importance of processing and packaging of Malewa. The objectives included analyzing the challenges and prospects of processing; and strategies to sustain Malewa as economic activity in this region. A descriptive study based on a literature survey and the author's own opinion, experience, and judgment was used. In-depth interviews were conducted with 08 participants (04 processors and 04 vendors). The results indicated that; most people in the Bugisu region are not aware that Malewa has other benefits apart from being used as a food delicacy. Appropriate processing and packaging can enhance the nutritional value, improve the quality, reduce wastage and contribute to the nutritional security of consumers hence enhancing demand and increased market base.

KEYWORDS: Malewa, value addition, food security, sustainable agriculture, descriptive.

INTRODUCTION

The increasing population worldwide has resulted in a decrease in the food basket causing serious questions on how effective the major food crops alone can contribute towards food security, poverty reduction and malnutrition, and maintenance of biodiversity. In most parts of the world, the most common agricultural products that are used to meet people's dietary needs and also used as a food preference include: include wheat, rice, cassava, potatoes, maize, plantain, sweet bananas, pineapples, passion fruits, groundnuts, and beans. These crops feed about 95 percent of the world's population (O. Santosh et al., 2019). To support the major food crops, extraction and utilization of products from natural ecosystems such as bamboo can help to reduce some of the issues affecting agricultural biodiversity.

Bamboo shoots, which are forest plants, can be used as an alternative food source to meet the dietary needs of people. They are one of the most useful plants on the earth with a lot of versatility and their development as a food crop guarantees their importance in contributing to food security (Sharma et al., 2018). The edible part of the shoot is derived from its young, immature, actively growing, and tender culm which emerges from the underground buds of the bamboo plants. The soft-edible part of the shoots is covered with a protective non-edible overlapping sheath which has to be removed to obtain the edible part. The bamboo crop is grown naturally without fertilizers or pesticides and with minimal water. Generally, the crop can be ready within 5-12 years and can be harvested each year without removing the clump for the next cycle of 30-50 years (Kaur Bajwa et al., 2021); this implies sustainability in crop production; as (Mwanja et al., 2023) also notes that Bamboo's important contribution to sustainable development lies in its fast growth which is about 3 to 5 years. Sharma, et al further points out that in general, harvesting of the bamboo takes two weeks. However, this may vary from one species to another depending on several factors such as soil fertility, drainage, and temperature among others.

1. BACKGROUND

Over View of Uganda's Bamboo Sector

In Uganda, Bamboo grows naturally and most bamboo resources are located in protected areas which are mainly forest reserves and national parks. Little information still exist on bamboo resources found on private land; and bamboo utilization and production is mostly limited to traditional practices, that are targeted at meeting subsistence needs and local markets which often demand low value products (Hillary A et al., 2022; O'Connell., 2020) . It is a forest resource that is seen to be used by the rural communities that

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depend on it for food, fuel wood, fodder, construction and craft materials among other uses. These communities access the bamboo either informally or through some collaborative arrangement with the authorities of the protected areas. Bamboo contributes to the economic development of the country through taxes on bamboo industries and products, tourist attractions, soil and water conservation, mitigation of climate change among others.

People in the communities surrounding the Mt. Elgon region, in eastern Uganda, who are called the 'Bamasaba' or 'Bagisu', eat the bamboo shoots; which is locally known as 'Malewa'. Bamboo shoots contribute about USD 1.5 billion to the global bamboo economy (O'Connell., 2020). Being highly confined to the informal local markets, data collection on bamboo production, consumption and export is puzzling. Much of the bamboo utilized in households is not reflected in the formal market statistics. Data on exports of raw bamboo and edible bamboo shoots remains largely undocumented (Hillary A et al., 2022).

Food insecurity in Uganda is still significant with 48 percent of the population experiencing average food insecurity and 11 percent with acute food insecurity and malnutrition in children, estimated to be about 2.4 million. Therefore, bamboo farming can be used as a solution to this issue since bamboo shoots are a rich source of vitamins, fiber, minerals and proteins; which makes it ideal for addressing the nutritional deficiencies in stunted children (HOW BAMBOO FARMING IN UGANDA, n.d.).

With support from the International Bamboo and Rattan Organization (INBAR), a ten-year (2019-2029) bamboo strategy and action plan for Uganda was developed to focus on the management of bamboo resources for economic, social and environmental benefits (O'Connell., 2020). The mission is "to build a robust bamboo industry in Uganda by sustainable management of bamboo resources and high value addition, contributing to gross domestic product growth, green economic development, job creation, and enhanced ecosystem services". In this strategy, it is stated that more research needs to be done along the bamboo value chain, that is; from identifying and multiplying suitable species for different areas and purposes to value addition and market identification for the various bamboo products. However, research activities on bamboo in Uganda as measured against its probable contribution to sustainable development are still small (Balikuddembe, 2023; O'Connell., 2020).

The global market for bamboo production is growing in response to the increasing demand for sustainable products (HOW BAMBOO FARMING IN UGANDA, n.d.). However, development and management of trade of this industry in Uganda is still lacking. There is a general lack of awareness, combined with poor perception of bamboo products having no market opportunity and being used by the poor. The purpose of this study therefore is to establish the impact of processing and packaging of bamboo shoots in Bugisu region in Eastern Uganda. Specifically, the paper analyses the challenges and prospects of processing bamboo shoots in this region and establish strategies that may be adopted to sustain it as a major economic activity that contributes to food security.

Processing of Bamboo shoots

Bamboo shoots are not only used as fresh but can also be processed and preserved in many different forms; dried, salted, fermented, marinated, and canned. The purpose of processing fresh bamboo shoots is to remove the anti-nutrients found in it that may not be good for consumption and to enhance the shelf life of the product since it is a highly perishable food commodity (O. . B. H. K. . B. M. S. . & N. C. Santosh, 2016). However, some processing methods such as marinating, boiling and drying may affect the nutritional value of the product (Bajwa et al., 2015). Drying and dehydration are the most important and widely used techniques as they are convenient for packaging, storage, and transportation (Nirmala et al., 2018). Processing is where a product is completely or partially transformed into one or more auxiliary goods (Rahaman et al., 2024). Therefore, bamboo can be processed into various auxiliary products with different nutritional values. The various nutrients contributing to the high-value food content of bamboo shoots include; amino acids, proteins, carbohydrates, vitamins, and dietary fibers (Sharma et al., 2018). The rich minerals contained in bamboos such as potassium, zinc, copper, manganese, calcium, and vitamins like vitamin A, vitamin B1, vitamin B3, vitamin B6 and vitamin E make it used as a source of medicine where it is beneficial to human health as it is said to promote peristalsis of the stomach and intestine, which helps to digest, prevent and cure cardiovascular diseases and some cancers. This has been used more especially in countries like China and Northeast Asia. The nutritiousness of bamboo has made it gain popularity worldwide as a health food (Kaur Bajwa et al., 2021).

Nowadays, consumers have become more health-conscious and therefore the demand for healthier food is increasing. Attention is now being given to foods that have valuable amounts of minerals, vitamins, dietary fibres, micronutrients, and antioxidants; of which culm flour from young bamboo shoots has been found to provide this health benefit (Nirmala et al., 2018). Fresh or fermented shoots of different bamboo species have been used to prepare many value-added products; and these products occupy a substantial position in the 21st-century market (Kaur Bajwa et al., 2021). Examples of the value-added products include; biscuits, crackers, nuggets, candies, chips, cookies, chapattis, buns, and chutney (O. . B. H. K. . B. M. S. . & N. C. Santosh, 2016). Appropriate utilization of this health food can be used to overcome malnutrition problems that are common, especially in rural areas (O. Santosh et al., 2018). Therefore, the need for processing bamboo shoots is a key activity in the food supply chain as this can be used for the production of novel and healthy food items; hence reaping all the benefits of bamboo shoots.

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Importance of packaging

Packaging is the art or science of developing a container for a product. Packaging fulfills many key roles in the food industry. Packaging acts as a shield against external elements like insects, light, heat, oxygen, bacteria, and odors, hence preserving food products during their shelf life. It safeguards product quality and consumer safety, facilitates logistical efficiency, it acts a marketing tool by conveying vital information through branding and labeling which meets the needs of modern consumers for convenience and time-saving (Bhatlawande et al., 2024). Processing and Packaging are significant activities in the Agricultural Supply Chain (ASC) as this helps to minimize food wastage (El jaouhari et al., 2024). Proper processing and packaging help to ensure food safety as this has now become a global health issue in efficient supply chain management. Consumers now demand more from sellers on food-related information and increased levels of safety about the products they consume. This information can help to make the environmental information of green products transparent and allow for traceability benefits (Mane et al., 2024; Rahaman et al., 2024).

Today, peoples' eating habits have changed due to their busy schedules which has made them not to have much time to spend in the kitchen to prepare health and nutritious home-made food. Very many cases of obesity are increasing among children. This has resulted in many cases of malnourishment. Deficiency in food nutrients is because people focus only on a few food crops and ignore or not using a large segment of nutritious edible plants such as bamboo shoots (O. . B. H. K. . B. M. S. . & N. C. Santosh, 2016; O. Santosh et al., 2019). Bamboo shoots are widely available in the Bugisu region in Eastern Uganda since it is consumed as a food delicacy among the Bamasaba (the indigenous people). However, given its versatility as a high-content nutritious food crop, its potential for food is underutilized. With the increasing demand for organic products, the need to establish the importance of processing and packaging of bamboo shoots becomes key.

2. MATERIALS AND METHODS

Preliminary research through a literature review was conducted to gain insights into the processing and packaging of bamboo shoots in the Bugisu region in Eastern Uganda. The researcher used purposive sampling to choose the respondents who were involved in processing and selling of bamboo shoots. Those who participated in the study were randomly selected. Sironko district was chosen due to its proximity to the forest reserve and Mbale district was chosen because it is the commercial centre of all the districts that constitute bugisu region. In-depth interviews were conducted with 08 participants; of which 04 were involved in processing and 04 were vendors of bamboo shoots to establish their perception of the activities involved in the processing and selling of bamboo shoots, and what can be done to improve the quality of this organic food to make it have a high market value. The data from the interviews and observation were transcribed and later translated into English since majority of the respondents didn't speak English. All the analysis was made manually; where the first analysis was on the vendors and the second analysis was on processors.

3. RESULTS AND DISCUSSION

The findings of the study began with the demographic characteristics of the respondents, continued with the activities involved in processing the Malewa, and then the importance of packaging.

Demographic background of the respondents

The study involved eight (08) participants from Sironko district; out of which 04 were involved in the processing of bamboo shoots and 04 were vendors of vendors. The table below shows the demographic characteristics of the respondents.

Table 1: Demographic characteristics of the respondents

Respondents	Characteristics			
	Gender	Age	Location Village/District	Duration in processing/vending Malewa
Vendor 1	Female	30	Mabaale/Sironko	2
Vendor 2	Male	23	Buyama/Sironko	3
Vendor 3	Male	24	Kinyewa/Sironko	5
Vendor 4	Female	70	Buyama/Sironko	20
Processor 1	Male	28	Zesui/Sironko	2
Processor 2	Male	29	Zesui/Sironko	14
Processor 3	Male	25	Namaangu/Sironko	10
Processor 4	Female	60	Bumboi/Mbale City	5

Source: Author's field data

In general, all the vendors that were randomly selected for this study are from Sironko district, who are all still energetic, with experience of less than six years in selling bamboo shoots; except one who is 70 years, with about twenty years of selling the shoots.

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All the processors are also from Sironko with the exception of one from Mbale who was chosen purposively because she has been involved in this activity for a long period. They are all still energetic and have good experience in processing bamboo shoots with the exception of one who had only two years' of experience.

Source of the bamboo shoots and challenges faced

Vendor 1- She sells the fresh ones. She buys from those who bring from the forest on Mondays and Fridays. Sometimes she delays to get the bamboo shoots because of transport challenges. The means of transport is a public motorcycle commonly known as Bodaboda, which may not be readily available. The fresh bamboo shoots can easily decay which causes loss. Beyond one week, it becomes spoiled; and because of the short life span of the fresh ones, she sells to other vendors in the main market in Mbale city. She said there is little profit (about UGX 5000 which is equivalent to 1.4 USD/25 Kg of fresh bamboo shoots) that she gets after selling. She does not know what people think about the processed bamboo shoots. She said it's not easy to package the bamboo shoots and she does not agree with the issue of packaging it because, for her, the fresh ones seem not to be easy to package.

Vendor 2- He buys from the people who get it from the forest. He observed that profits depend on the turn up of customers, but generally, there was little profit; though he didn't disclose how much. If he fails to get buyers, he takes to another market. The bamboo shoots can easily rot when kept inside the house. To avoid rotting, the fresh ones can be kept in a cold place outside the house for a week. On the issue of other benefits of bamboo shoots, he said he did not know any other use apart from being used as a delicacy (sauce). He acknowledged that the dry ones can be packaged and can be sold to other places even outside the country. For him, the easiest way to package was the use of polythene bags.

Vendor 3- He gets the shoots from the people who bring from the forest and then sells it in Mutuufu market; which is another market from his hometown where buyers from the city come to buy. It is a seasonal crop which is in abundance from April to September each year. His perception is that; the bamboo shoots can only be sold in Bugisu region because it is a traditional delicacy of the Bamasaba people. He saw no need to package the bamboo shoots. The smoked ones can be kept for a long time, unlike the fresh ones which can easily rot.

Vendor 4- She gets it from other vendors in the market. Sells and gets little profit out of it; though the profit was not disclosed. She has to pay taxes from the little profit she gets. She deals in the dry ones because she can keep them for a long period. She did not have an idea about the issue of packaging the bamboo shoots.

Processor 1- He gets the bamboo shoots from Zesui forest. The forest is found in a national park which is a gazetted government land. Access to the forest is not easy so they talk to the guards to allow them to access the forest. He only knows that it can be used only as a delicacy for sauce and not any other use. He was not sure about packaging of the bamboo shoots because for him he has just entered into the business of processing and mostly he sells the fresh ones; and to him, if the fresh ones are to be packaged, some people will not buy. If it is well-smoked, it can stay for a period of like two years.

Processor 2- He gets it from the forest. They give money to guards to grant them access to the forest. It is available from April to July each year. Outside the mentioned months, no income from bamboo shoots except the smoked ones which one may have kept to last long. They get little profit but was hesitant to disclose how much. Had no definite response on the issue of packaging.

Processor 3- He gets from the government forest. They are not allowed to access the forest but they stealthily go there and if they are got, they can be jailed. Access to the bamboo shoots in the forest is not easy as this involves moving through thick grass which limits movement, rain is also a challenge which limits movement within the forest. There are some wild animals that may attack the people processing the bamboo shoots. Branches from other trees in the forest can fall and harm someone while smoking. The little profit got from the bamboo shoots is used to buy fertilizers to be used in other crops they grow like maize, tomatoes, cabbages, etc. If the bamboo shoots is smoked, it lasts a long time and it can be packaged and can be sold anywhere which creates more market. He recommends that people should continue consuming it because it has health benefits. The cheapest way to package it is using polythene bags. He agreed that packaging can reduce wastage.

Processor 4- She buys fresh bamboo shoots from other vendors who get it from the forest. She processes the shoots by steaming and salting it, then packs it in plastic containers. She said that if she gets access to technology to help her process the bamboo shoots, this would add more value and help her to increase the quantity that she makes. She also acknowledged that packaging the bamboo shoots helps to reduce wastage and spoilage and also facilitates easy transportation. She said that bamboo shoots has health benefits like a cure for joint pain.

In general, the source of the bamboo shoots is from the forest which is a gazetted government land. This means that access to this forest is restricted. The people who go there to get the bamboo shoots have to get permission from the guards and sometimes they are not allowed so they end up bribing the guards to be allowed. The bamboo shoots are a seasonal crop; they are available from June to July each year. Apart from being restricted from accessing the bamboo forest, those who go there face other challenges like water-logged places whereby if someone is not careful, they can drown in such water. Some plants in the forest can limit easy movement as they can tie around one's legs and then a person can easily fall hence get injured. In the process of getting the shoots from the ground, one can easily get pierced; therefore, there is a need for a person to be careful. All the vendors noted that there was

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little profit realized from the sale of bamboo shoots; though most of them were hesitant to disclose how much they get as they thought that the researcher was an authority from the tax body who wanted to charge them taxes.

How the Bamboo shoots are processed in Bugisu

After getting the shoots from the forest, the outer leaves (sheath) are removed as those are not edible. The bamboo shoots are then sliced and placed on the prepared wooden hanger to be dried using fire. The shoots are placed on top and then the fire is placed below the wooden hanger. One has to keep monitoring as the shoots get roasted to avoid being burnt. So, the bamboo is left to dry through the smoke from the fire. The more time it is left to dry in the smoke, the more the shelf life of the product. This can take 24 hours (one) day to dry. Processing of the bamboo also has its own challenges. If the bamboo shoot is not sliced and then put directly into fire, it can burst and the water can burn a person. If it is not well processed and not well stored, it can develop molds; implying it can have a short shelf span. The fresh bamboo shoots can easily go bad hence making a loss to the sellers. The processors were reluctant to disclose how much profit they get from this activity as they thought that the researcher was a government official who wanted to know how much they get so that they could be taxed. On the issue of processing the bamboo using any other ways apart from fire; the processors said they were not aware of any other method they could use to process it. They only use fire and sometime after it has been smoked, it can be placed in the sun. As observed from the literature, there are many other ways in which the bamboo shoots can be processed such as drying, salting, fermenting, marinating, and canning (O. . B. H. K. . B. M. S. . & N. C. Santosh, 2016).

Other benefits of bamboo shoots

The majority of the respondents, when asked whether they knew any other benefits of bamboo shoots; confirmed that they only knew it as a food delicacy; whereby they said that when soda ash is used to prepare it, it can help in healing joint pain. This implied that most people in the Bugisu region are not aware that bamboo shoots has several benefits as indicated in Table 2.

Table 2: Benefits of Bamboo Shoots found out from various studies

Benefits	Nutritional contents	Reference
Source of food. Shoots are used in dumplings, soups, salads, noodles, and gravies.	Amino acids, proteins, carbohydrates, vitamins, and dietary fibers. Minerals like potassium, phosphorus, and sodium	Sharma. V., Thounaojam, P., Nirmala, C. & Bisht, M., S. (2018).
Putative health benefits Bamboo leaf antioxidants are very effective in retarding lipid oxidation and preventing biogenic amine formation in pork sausage when combined with tea polyphenols. Amino acids not synthesized in the human body can be obtained from bamboo shoots. Phytosterols in processed bamboo shoots can lower serum cholesterol levels in humans and help reduce the risk of heart disease. Food fortification. Several value-added products such as chicken nuggets, crackers, chutney, snacks, cookies, cakes, chapattis, and buns have been prepared from bamboo shoots, Battered and breaded fish balls, biscuits, milk puddings, etc.	Selenium, zinc, copper, iron, and manganese. Minerals, vitamins, and amino acids	Nirmala, C., Bisht, M, S., Bajwa, H., K. & Santosh, O. (2018). Bajwa, H., K., Santosh, O., and Nirmala, C. (2021). Santosh, O., Bajwa, H., K., Bisht, M., S. & Nirmala, C. (2018b). Bajwa, H., K., Nirmala, C. & Bisht, M., S. (2015)
Reduction of micronutrient malnutrition through food fortification Proteins are important for growth and development and are also required for the	Proteins, carbohydrates, and minerals like potassium, phosphorus, sodium, calcium, magnesium, and iron. Minerals such as potassium, phosphorus, sodium, calcium, magnesium, and iron Vitamins, and fiber and low in fat and sugar. Amino acids.	Santosh, O., Bajwa, H., K., Bisht, M., S. & Nirmala, C. (2016).

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maintenance of all biological functions of the body. Minerals are required for the proper functioning of many useful metabolic activities of our body. Bamboo shoots are also a good multivitamin food that can act as a foundation for good health.		
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Source: Literature review on benefits of bamboo shoots

Packaging of bamboo shoots

On the issue of packaging, only a few respondents knew the importance of packaging the bamboo shoots, others seemed not to have a proper understanding of packaging it. Packaging plays an essential role in the food industry today to improve food safety and guarantee quality. The use of Antioxidant releaser films as part of active packaging has the following advantages; extends the shelf life of perishable food products and reduces food waste; prevents the growth of bacteria, fungi, and other micro-organisms that may contaminate food hence reducing the risk of spoilage and foodborne diseases. It also increases food safety and quality more so in ready-to-eat products (Bhatlawande et al., 2024).

Packaging systems also help to minimize food loss by preventing product damage, especially during transportation activities (Perdana et al., 2023). Packaging can also be used to maintain the freshness, appearance, and nutritional content of food (Fadiji & Pathare, 2023). This, therefore implies more awareness has to be created on the importance of packaging bamboo shoots as an organic product to maintain its nutritional value. The rapidly growing food industry today has generated a desire for enhanced food quality and safety which has stimulated revolutionary innovation in packaging technologies (Fadiji & Pathare, 2023).

Strategies to sustain this food delicacy to remain a major economic activity in Bugisu

On the issues of sustainability of the bamboo shoots, most of respondents looked pale as they didn't have an appropriate response to this. They said that since they did not own the land where the bamboo shoots were found, they didn't know what to do to sustain it. For them they wait for the season to reach, they go to the forest get the shoots, and then distribute it to the vendors/processors. So, this was a cyclical process that they went through without any measures of how to sustain the crop. This therefore implies that the sustainability of bamboo shoots as an organic crop is lacking and therefore there is a need for support from the government if the rural communities in this region are to benefit from this crop. The issue of sustainability requires various stakeholders that can balance the economic, social, and environmental issues (Buranasiri et al., 2024). Worldwide, many bamboo-based food enhancements and drugs are being manufactured and marketed and this has seen bamboo shoots become a lucrative business with countries like China, Taiwan, and Thailand being the largest supplier to the world market (Kaur Bajwa et al., 2021). With the application of appropriate agricultural system management, bamboo shoots in the Bugisu region can sustainably become a key economic activity that enhances peoples' standards of living.

4.0 CONCLUSION

This work draws on the importance of processing and packaging of bamboo shoots. The underutilization of bamboo presents an opportunity to reap economic benefits and also plays an important role in promoting health food and security within the local communities. Through appropriate cultivation, processing, and packaging, bamboo shoots have the potential to add economic value to all the stakeholders in this food supply chain. Studies should be conducted on which cost-effective technologies can be used to process the bamboo shoots. To ensure sustainability, the use of eco-friendly packaging materials should be encouraged. For example, the use of grown bamboo wood to make packaging for the bamboo shoots for purposes of storage to enhance food quality and safety and also minimize food losses. The use of environmentally friendly packages can also be adopted to facilitate distribution. Communication and knowledge management systems should be developed to create more awareness. Training and research in bamboo education and market development is needed.

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Figure 1: Fresh bamboo shoots from the forest bundled for sale in the local market.



Figure 2: A bamboo shoot processor removing the outer sheath to get the shoots ready for smoking. In the background; on the wooden counter; smoked bamboo shoots are put outside in the sun to keep them fresh.



Figure 3: Smoked bamboo shoots for sale in the market. The whitish substance is the mold that may develop due to poor storage.



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