

Survey of Sweet Potato (*Ipomeas batatas*) Storage and Preservation Methods and Delicacies in Southern and Central Côte d'Ivoire

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To cite this article:

Aïssatou Coulibaly, Yapi Elisée Kouakoua, Adam Camille Kouame, Ahou Anicette Kra, N'Guessan Georges Amani. Survey of Sweet Potato (*Ipomeas batatas*) Storage and Preservation Methods and Delicacies in Southern and Central Côte d'Ivoire. *Journal of Food and Nutrition Sciences*. Vol. 11, No. 5, 2023, pp. 154-160. doi: 10.11648/j.jfns.20231105.13

Received: September 30, 2023; **Accepted:** October 20, 2023; **Published:** October 31, 2023

Abstract: The methods of storing and preserving sweet potatoes and the resulting foods in Côte d'Ivoire are poorly documented. The aim of this study was to compile a list of these methods and foods. A survey was carried out among producers in the Bouaké and Agboville, which are among the major producing areas. The survey focused on producers' knowledge of the varieties grown, farming practices, storage and conservation methods used, and the food. The results showed that two (2) sweet potato varieties are grown predominantly in Agboville and one (1) variety in Bouaké. Sweet potatoes with purple skin and yellow flesh (100%) are found in Bouaké, while in the Agboville area the sweet potatoes are found to have beige skin with white flesh (40%) or purple skin with white flesh (60%). The storage method most commonly used in both departments is bulk storage. Sweet potato dishes vary from one department to another. However, the most popular dish in Bouaké is boiled potato (87.6%) and in Agboville it is chips (86.2%). This study provided information on storage and preservation methods and culinary preparations in southern and central Côte d'Ivoire. It showed the need to propose other storage methods to farmers.

Keywords: Sweet Potato, Preservation, Storage, Food Processing, Côte d'Ivoire

1. Introduction

Native to tropical America, sweet potato (*Ipomoea batatas*) is a member of the Convolvulaceae family grown in tropical and subtropical areas [1]. Its annual global production exceeds 100 million tonnes, and it ranks 5th among food crops behind rice, wheat, maize and cassava [2, 3]. In tropical countries, it is second among roots and tubers after cassava [4]. The five main sweet potato producers are China, Nigeria, Uganda, Indonesia and the United Republic of Tanzania [5]. In sub-Saharan Africa, sweet potato is third, behind cassava and yam [6], although it adapts well to poor soils [7]. It has a short reproductive cycle (3 to 5 months) unlike other crops such as yam [8, 9].

In Côte d'Ivoire, sweet potatoes are grown in all regions

and account for a large proportion of food consumption and are a significant source of income [3]. National sweet potato production is estimated at 58520.28 tonnes [4]. The marketing of sweet potatoes enables producers to increase their income and contributes to the growth of the country's Gross Domestic Product (GDP) [10]. However, it is one of the most neglected and underexploited food crops [11], despite the fact that nutritionally speaking, sweet potatoes are an important source of carbohydrates (96%), dietary fibre [12, 13]; and also contain vitamins, the most important of which are vitamins C, B (B1, B2, folic acid) and E, as well as minerals and proteins [7, 8]. Leaves are also a good source of energy, vitamin A, zinc, calcium, and protein [8].

Due to their high nutritional value, productivity and low input requirements, sweet potatoes have become a valuable food in developing countries [13]. Despite their nutritional

and economic importance, sweet potatoes suffer from post-harvest losses. It is difficult to preserve because it is highly perishable [14]. Poor storage of these tubers under ambient conditions remains a major constraint for farmers [15]. Moreover, according to [16], sweet potatoes are attacked by pests both in the field and during storage. The best-known enemy is the weevil (*Cylas puncticollis*), which causes losses ranging from 50 to 75% of the harvest. Elsewhere, there are traditional and improved traditional methods of sweet potato storage, namely the silo-pit; above-ground storage, heap storage, platform storage, pit storage, the sandbox method and shaded, mulched pits, etc. [17]. Despite the existence of these methods, post-harvest losses are observed in production areas, suggesting the need to investigate these existing storage practices. Improved storage methods can improve the supply of sweet potato tubers throughout the year and add value to the crop, thus increasing farmers' incomes and potentially improving their quality of life. Tuber storage and quality preservation are key elements in the supply chain. Processing is also one of the most effective methods of reducing post-harvest losses. Unfortunately, processing is still carried out in the informal sector, and there is little public awareness of the food derived from it.

In Côte d'Ivoire, no systematic work on storage methods

and losses has been carried out to date. Therefore, it is vital to be familiar with all the storage methods used in the country. Mastering these techniques will not only reduce post-harvest losses but also guarantee the availability of the potato. Moreover, preserving the quality of sweet potato tubers during storage is necessary for the processing industry and to avoid high economic losses. Obviously, we need to know more about the culinary uses of this foodstuff so that we can make better use of it. This is the background to this study, which aims to guarantee the availability and value of sweet potatoes in Côte d'Ivoire. The general objective of this work was to list all the preservation techniques and dishes derived from this food.

2. Material and Methods

2.1. Study Areas

The studies were carried out in the south and center of Côte d'Ivoire, in the Agnèby-Tiassa and Gbêkê regions, respectively, more specifically in the Agboville and Bouaké (Figure 1). The department of Agboville is located between latitudes 5.9664° North and longitudes 4.3154 ° West, while that of Bouaké is located between latitudes 7.8429 ° North and longitudes 4.9767° West.

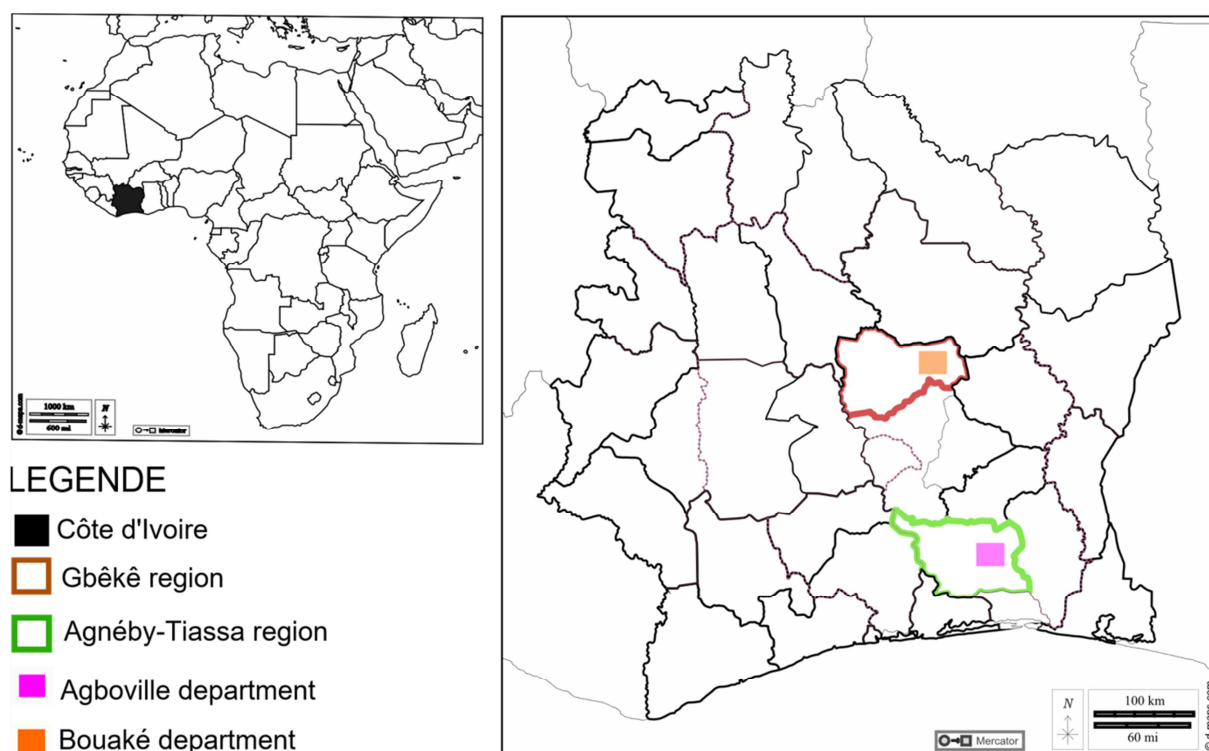


Figure 1. Study zone.

2.2. Selection Criteria and Data Collection Methodology

Twelve (12) villages (Table 1) were selected on the basis of sweet potato production after surveys conducted with the Ministry of Agriculture and Rural Development and a

pre-survey in markets in the city of Abidjan. Survey data were collected from producers in groups or individually at home or in fields during May and June 2023. Producers were identified with the help of village chiefs. The number of producers surveyed per village was 30. Information such as sweet potato varieties grown, cultivation techniques, storage practices,

preservation practices and sweet potato-based dishes were included in the questionnaires. Socio-demographic data (age, household size, gender, level of education and ethnic group) were collected.

Table 1. List of villages surveyed.

Number	Villages	Regions	Departments
1	Aboudé kouasside	Agnéby-Tiassa	Agboville
2	Aboudé Mandeké		
3	Offoumpo		
4	Adimpo		
5	Kahankro		
6	Affouekro	Gbêkê	Bouaké
7	Fari Oko		
8	Kouadio-Manankro		
9	Yapo kouakoukro		
10	Totimbo		
11	Tanou sakassou		
12	Senzenou		

2.3. Statistical Analysis of Data

Survey data collected in the two study areas were processed using IBM SPSS Statistics 2.0 software. Data were analyzed using descriptive statistics. The average number of modalities per department was determined, and their frequencies were calculated to assess the extent of their distribution. The Pearson Chi-square test was used to assess the variability of the criteria between departments.

3. Results

3.1. Sociodemographic Characteristics

Table 2 shows the socio-demographic characteristics of the growers interviewed in the study areas of Bouaké and Agboville. The results show that sweet potato cultivation is largely dominated by women. 81.95% of the growers interviewed were between 25 and 50 years old and the majority were illiterate. With regard to ethnic group in the Bouaké area, all the growers were Akans, while in Agboville the majority of growers were Burkinabe and Mande from the north.

Table 2. Socio-demographic characteristics of the producers interviewed.

Characteristics of producers	Agboville (%)	Bouaké (%)	Total (%)
Sex			
Feminine	65	62.5	63.75
Male	35	37.5	36.25
age range			
Under 25	7.5	6.2	6.85
25-50 years old	81	82.7	81.95
50 years and over	11.2	11.1	11.15
Educational level			
Illiterate	95	69.1	82.05
Primary	2.5	23.5	13
Secondary	2.5	7.4	4.95
Ethnic group			
Akan	2.5	100	51.25
Burkinabé	56.2	0.0	28.1
Northern Mande	38.8	0.0	19.4
Nigerian	2.5	0.0	1.25

3.2. Cultivated Sweet Potato Varieties

The varieties grown and their vernacular names are shown in Figures 2 and 3 respectively. Three (3) varieties were identified in the two departments surveyed. However, the sweet potato varieties grown in the Bouaké and Agboville areas were different. In Bouaké, growers cultivate the violet-skinned variety with yellow flesh, while in Agboville they grow the beige -skinned and violet-skinned varieties with white flesh. In Bouaké, the sweet potato was known as *alenda*, whereas in Agboville it is known by several names: *alenda*, *koudakou*, *wosso*, and *patates bonjour*.

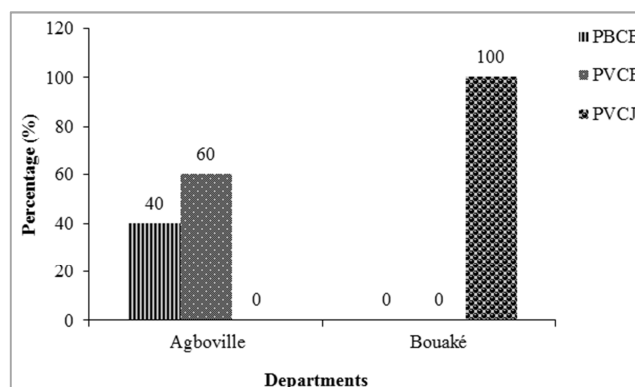


Figure 2. Varieties of cultivated sweet potatoes.

PBCB: potato with beige skin and white flesh; PVCB: potato with purple skin and white flesh; PVCJ: potato with purple skin and yellow flesh

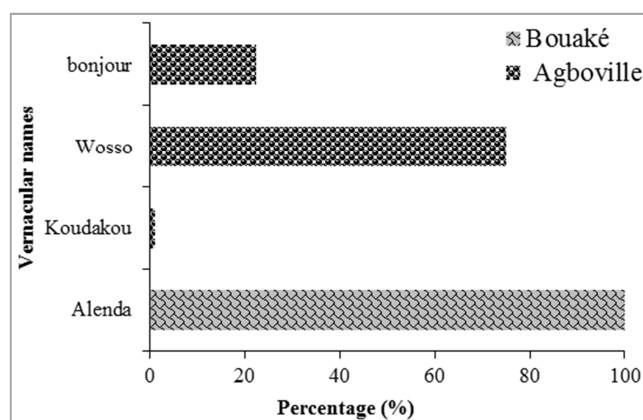


Figure 3. Local names of sweet potato by department.

3.3. Input Use and Harvest Period

Table 3 presents the results on the use of inputs and the harvest period for sweet potatoes. In all zones (Bouaké and Agboville), farmers do not use fertiliser in sweet potato cultivation. In contrast to fertiliser, pesticides are widely used in the department of Agboville. The sweet potato harvest period in both zones is 3 months. During harvest, the losses observed are rotting, wounds, and damage caused by insects. In Bouaké, the most common losses observed by the growers were rot and injuries, while in Agboville, the most common losses were rot and insect damage.

Table 3. Input use and sweet potato harvesting season in the Agboville and Bouaké zones.

Characteristics of producers	Agboville (%)	Bouaké (%)	Total (%)	Chi2	ddl	P value
Use of fertiliser						
Yes	2.5	0	1.25	2.025	1	0.155
No	97.5	100	98.75			
Pesticide use						
Yes	100	0	50	160.000	1	P<0.05
No	0	100	50			
Harvest period						
3 months	98.8	100	99.4	1.006	1	0.071
4 months	1.2	0	0.6			
Types of losses during harvest						
Rot	55	50	52.5	160.000	2	P<0.05
Injury	30	5	17.5			
Insect damage	15	45	30			

3.4. Preservation Methods for Sweet Potato Tubers

Figures 4 and 5 present the preservation techniques and their effectiveness. The results obtained in the field made it possible to list three (3) preservation methods (in bulk, in water, and on the ground) used by producers. Of these 3

methods, bulk storage was the most widely used, regardless of the production area. Despite the use of this method, effectiveness differed ($P<0.05$) from one zone to another. With bulk storage, Bouaké sweet potatoes lasted two (2) weeks, while in Agboville they spoil after three (3) days.

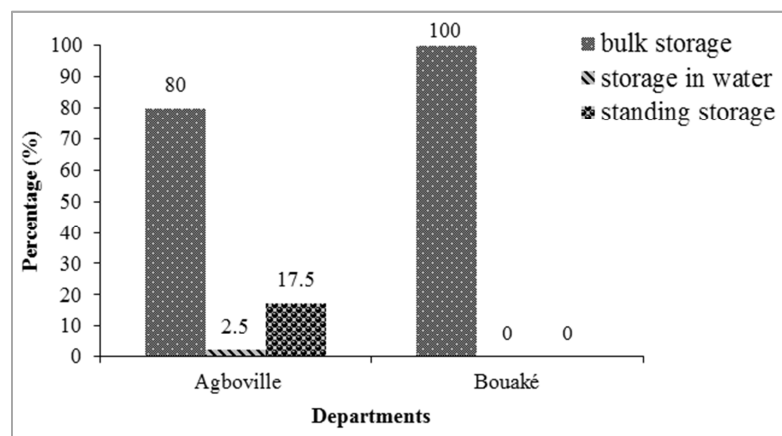


Figure 4. Techniques for preserving potatoes.

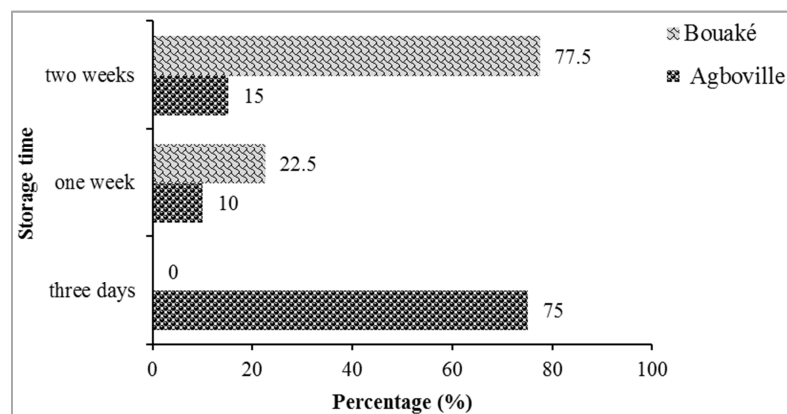


Figure 5. Effectiveness of bulk storage according to producers.

3.5. Level of Loss and Factors Influencing Storage

Table 4 shows the types of loss observed during storage. Despite the use of conservation techniques, post-harvest

losses are high in both departments. These losses are mainly rot and loss of mass. According to the growers, the losses observed in both areas were mainly caused by heat. In the Agboville area, growers also pointed to fertiliser as a factor in

potato deterioration.

Table 4. Characteristics of losses during storage in the departments of Bouaké and Agboville.

Characteristics of producers	Agboville (%)	Bouaké (%)	Total (%)	Chi2	ddl	P value
Type of loss						
Rot	65	50.55	57.78	160.000	3	P<0.05
Wilt	15	19	17			
Weight loss	20	30.45	25.23			
Pests	0	0	0			
Estimated losses						
Student	90	98.8	94.4	9.325	2	0.008
Low	1.2	0	0.6			
Medium	8.8	1.2	5			
Cause of losses						
Moisture	2.5	0	1.25	28.235	3	P<0.05
Heat	61.2	100	88.1			
Pesticide	3.8	0	1.9			
Fertiliser	32.5	0	8.75			

3.6. Sweet Potato Dishes

Figures 6 and 7 show sweet potato dishes and their frequency of consumption by people in the south and center of the country. The results of this survey show that the culinary practices and consumption frequencies for sweet potato consumption in the two production zones are different ($P<0.05$). In the department of Agboville, the sweet potato-based dishes consumed by producers are porridge and chips, with a strong preference for chips. However, consumption in this area is very low. In Bouaké, in addition to the other two dishes, the potato is eaten in the form of foutou, konkondé and braised. In this area, potatoes are consumed in large amounts, with boiled potatoes predominating.

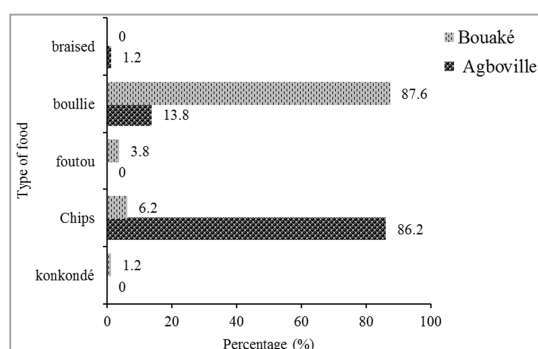


Figure 6. How to eat sweet potatoes.

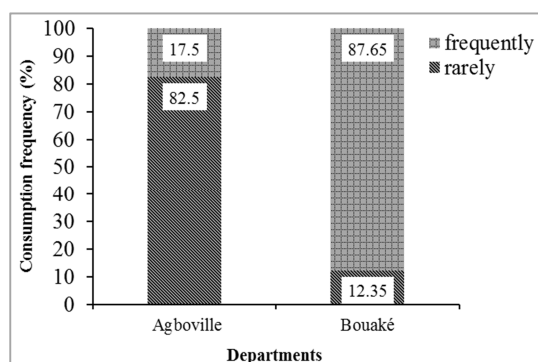


Figure 7. Frequency of consumption of sweet potatoes.

4. Discussion

In all the areas surveyed, three (3) local sweet potato varieties were identified. Tuber is produced for marketing and self-consumption. Like cassava and yam, which are the main crops in Côte d'Ivoire, sweet potatoes can play an important role in the fight against poverty.

Of these 3 varieties, those with purple skin and yellow flesh are grown in Bouaké and those with beige and purple skin and white flesh are grown in Agboville. The choice of varieties could be explained by cultural adaptation, insect resistance and culinary adaptation [18]. The departments of Bouaké and Agboville are located in two different climatic zones. Rainfall is higher in the south (Agboville) than in the center (Bouaké) [19]. As a result, some varieties may not develop well in certain areas.

Regarding the vernacular name for sweet potatoes in these areas, only the department of Agboville has several vernacular names (*alenda*, *koudakou*, *wosso*, *bonjour*). In this department, the producers interviewed were mainly halogens (Burkinabés and Mandés from the north). Thus, the vernacular name would be linked to the origin of these peoples. Unlike Agboville growers, the Bouaké growers, who are mainly Baoulé, call the sweet potato *alenda*. According to [20-23], the vernacular names traditionally given to varieties vary most often between villages in the same area and sometimes even between farmers in the same village. Like sweet potato, several vernacular names have been given to other crops such as fonio, traditional leafy vegetables and cassava [24-26].

Farmers in the Agboville area use pesticides for weeding. This practice is commonly used by some growers, as it is faster and requires less energy [27-29]. However, it should be noted that Bouaké farmers use fewer pesticides. The use of pesticides and chemical fertilisers has a negative impact on tuber quality. [30], observed this on yam tubers from fields treated with herbicide. According to these authors, chemically treated tubers had difficulty keeping after harvest. The sweet potato harvest period reported by growers begins after 3 months of sowing in both departments studied. This harvesting period would be

linked to the variety, since according to the study by [31], the varieties grown in Côte d'Ivoire have a harvesting period ranging from 3 to 5 months.

The traditional methods of preserving sweet potatoes (storage in bulk, in water and on the ground) used by producers in the two departments are not very effective, as they only preserve sweet potatoes for 3 to 14 days. Despite their inefficiency, these methods are the most widely used by farmers. The same conservation techniques are also used in Benin and Niger [18, 32]. Field data have also shown that potatoes produced in Bouaké (yellow-fleshed potatoes) keep better than potatoes produced in Agboville (white-fleshed potatoes). The storage qualities of potatoes are believed to be linked to their biochemical nature. According to [33], yellow-fleshed potatoes are less water rich than white-fleshed potatoes. Water is a determining factor in food preservation. The more water a food contains, the more likely it is to spoil. The storage resistance of yellow-fleshed potatoes compared to white-fleshed potatoes has also been highlighted by [34]. The damage most often observed is rotting and loss of tuber mass. This damage can be explained by the temperature, which is well above the average required for preservation (16°C), and also by the high respiration rate of this tuber [35]. It should also be noted that the Agboville growers emphasised the role of fertiliser in the deterioration of the sweet potato. According to them, tubers treated with chemical fertilisers do not keep well. It is therefore necessary to improve these traditional techniques, as was the case in East African countries such as Zimbabwe, where harvested tubers are mixed with ash powder [36]. According to these authors, ash absorbs moisture, slows respiration, and has a repellent effect on pests.

5. Conclusion

The purpose of this study was to identify storage and preservation methods and sweet potato-based dishes in sweet potato-producing areas. Few methods are used in these areas. Bulk storage is the technique most widely used in these two production areas, with a shelf life ranging from three days to two weeks depending on the variety. As far as culinary practices are concerned, the sweet potato is enjoyed in its original form (boiled and fried) in the Agboville area, while in Bouaké it is eaten in various forms (boiled, fried, braised, foutou, and konkondé).

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