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Local food processing and associated hygienic quality in greater Lomé, Togo: Traditional cooked corn-based dough akpan wrapped in *M. cuspidata, M. mannii* and *M. purpurea* species leaves

Mamy Eklou*[1], Komlan Edjèdu Sodjinou[3], Kodjo Djidjolé Etse[3], Awidèma Adjolo[3], Benziwa Nathalie Johnson[3], Bayi Reine Dossou[2], Yaovi Ameyapoh[1], Raoufou Radji[3], Akossiwoa M-L Quashie[3]

[1]*Laboratory of Microbiology and Food Quality Control (LAMICODA), University of Lomé, Lomé, Togo*
[2]*Higher School of Biological and Food Techniques (ESTBA), University of Lomé, Lomé, Togo*
[3]*Physiology-Horticulture-Biotechnology Team (PHOBIOT), Forestry Research Laboratory (LRF), Climate Change Research Center (CRCC), University of Lomé, Lomé, Togo*

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ABSTRACT

Marantochloa cuspidata, *Marantochloa mannii*, and *Marantochloa purpurea* are plant species widely used in the packaging of dough made from non-fermented corn flour. However, the hygiene conditions surrounding the production and packaging processes for the dough made from these leaves involve several risks that only scientific analysis can determine. Experimental observations were therefore made on the packaged doughs to observe weight loss over a period of 10 days. At the same time, the presence of mesophilic aerobic flora, total coliforms, *Escherichia coli*, sulfite-reducing anaerobes, *Salmonella* sp. and *Staphylococcus aureus* was studied. The following analysis standards were used as references: NF EN ISO 4833-1; NF EN ISO 4832; NF EN ISO 16649-2; NF EN ISO 15213; NF EN ISO 6579-1; NF EN ISO 6888-1. Weight losses ranging from 9.52% to 10.06% were observed at one site and from 12.5% to 14.99% at the second site. Pseudomycelium, septate mycelium, and terminal chlamydospores were observed, as well as *E. coli*-type coliforms. In addition, neurospora molds were identified. At first glance, these results pose a public health problem, consumer exposure to risks of gastrointestinal illness of varying severity and allergies. The carbohydrate quality of the dough, as well as its texture, smell, and color, are degraded by the appearance of the neurospora molds observed. As these food losses have economic and ecological consequences, it is important to implement more innovative packaging processes for "akpan" in Greater Lomé in terms of hygiene so that consumers and producers can benefit from the phytochemical properties of the species observed.

***Corresponding author:** Mamy Eklou ✉ eklouenyae@gmail.com

INTRODUCTION

Like many countries in Southeast Asia and Latin America, sub-Saharan Africa boasts a fairly homogeneous diversity of flora, particularly in countries along the Atlantic coast (Duarte *et al.*, 2025; Hounsou *et al.*, 2022). These different plant species often have interesting medicinal, nutritional, and technological properties (Alum *et al.*, 2025; Erdaw, 2023; Tura *et al.*, 2025).

In these countries, from a technological and point of view, several plant species are used in traditional food processing methods, particularly for packaging (Tapsoba *et al.*, 2022). At first glance, these leaves are often chosen for their resistance to wear and tear and their phytochemical properties.

This endogenous food packaging technology of rural origin, based on the use of plant species, has been transposed to urban environments due to population mobility. These migrant populations, often composed of young men and women in search of a better life, are leaving their rural communities to move to the capital cities of their countries or even to those of neighboring countries (Chinda, 2025). The Autonomous District of Greater Lomé, Togo's leading urban center, is no exception to this trend.

In this city, "akpan" occupies a prominent place in the daily diet and nutrition of the population. Whether at lunch, dinner, breakfast, or even during festive or mourning events, this dish is often included among the meals served to guests. Not only is "akpan" widely consumed by the people of Lomé, but it is also very rich in carbohydrates, essential minerals (iron, magnesium, zinc, potassium, phosphorus) and vitamins (B1, B3, B5, B6). However, like similar dishes, "akpan" has been wrapped in leaves for centuries.

Marantochloa cuspidata, *Marantochloa mannii*, and *Marantochloa purpurea* are, based on empirical observation, among the plant species most commonly used to package "akpan" in Greater Lomé. Existing research has shown that packaging "akpan" with the plant species in question potentially promotes its portability in significant quantities, as well as its resistance to biochemical degradation or contamination (Fossou *et al.*, 2024). Hypotheses have even been formulated regarding the possible migration of nutrients from these leaves to the dough. Even within the dynamics of policies promoting local consumption, including references to endogenous knowledge and practices, the use of "akpan" packaging made from *Marantochloa cuspidata*, *Marantochloa mannii*, and *Marantochloa purpurea* is tending to disappear in favor of plastic packaging due to their gradually declining availability and physical accessibility (Poynter, 2025). Indeed, sourcing these plant species is more expensive than sourcing plastic packaging (Hounsou *et al.*, 2022; Kalina *et al.*, 2024).

But packaging this dough in plastic materials carries risks of chemical contamination for the end consumer (Seref and Cufaoglu, 2025). Nevertheless, the traditional method of packaging "akpan" using these plant species does not seem to protect consumers from biochemical risks and nutritional insecurity either, due to the hygiene conditions associated with production (Taale *et al.*, 2025). Furthermore, these challenges seem not to be the major priorities in the implementation of food and nutrition security projects and programs in the municipalities of Greater Lomé. In view of these challenges, the research aims to explore the nutritional, health, ecological and economic risks associated with the traditional packaging technique of "akpan" using *Marantochloa cuspidata, Marantochloa mannii, and Marantochloa purpurea,* in light of the observed hygienic conditions of production and microbiological analysis (Arshad *et al.*, 2025).

MATERIALS AND METHODS

Study physical environment

Plant material used for food wrapping was collected in May 2025 in forest galleries located on Plateau Akposso (Wawa prefecture, Plateau region in Togo) at an altitude between 738 and 826 m (7.52° latitude north and 0.81° longitude east).

Food processing was performed by two producers located in Lomé, the capital of Togo and especially in the neighborhoods of BC and TW. The producers own kitchens were the main production sites.

Plant material: Species, collection, transport and storage

Marantochloa mannii, Marantochloa purpurea and Marantochloa cuspidata, species were chosen for this experiment. After identifying the selected species in their natural environment, the leaves were cut with about 10 cm of petiole and in sufficient quantity to allow for all the planned tests. They were then stored in separated jutes bags so as to distinguish the collected species. A brief water spraying was carried out to keep permanent humidification during transport to the laboratory (Fig. 1).

A B C

Fig. 1. Plateau Akposso (Plateaux region in Togo): Collection of leaves from the various plant species studied- (overview of a collection area (A); identification and collection (B); *M. mannii* leaves upon a jute bag before transport (C)

At arrival, leaves were exhibited on workbenches at temperature of 24°C and maintained humidification to avoid leaf deterioration until the next day for use during food production (Fig. 2).

Fig. 2. Leaves exhibition on workbenches in laboratory

Food production

Three local producers were selected from three neighborhoods of Lomé (respectively named for confidential reasons, TW, BC and AV) to support the technical learning process. They were selected on the basis of their place of residence, assuming that populations are gradually distributed all around Greater Lomé according to their geographic and ethnic origins. Only two producers, located at TW and BC, were ultimately available to conduct the endogenous process. Non fermented corn-based dough cooking was performed according to their own process methods, with their own kitchen ustensils and in two different cooking environments. The wrapped products in various vegetable leaves were then conveyed to the laboratory and stored on the workbenches at room temperature.

Food storage and visual observation

The packaged paste was transported and stored in the laboratory for observation. It was arranged in samples of three according to species and place of production, the first production site being TW and the second site BC. The dough was observed for 10 days, from the first day (d_0) to the last day (d_9). The packaged paste was then weighed and arranged in the order mentioned above.

The weights (p1) were taken using an electronic scale (Nahita Blue brand; accuracy of 500g/0.01g, series 5162; capacity of 500g; sensitivity of 0.01g; tray dimensions 120×155 mm; power supply: 100-240VAC 50-60HZ.).

Weight measurements continued over the nine other days of observation for the samples according to species and place of production. The average weight loss per species and per production site was calculated using the following general formula:

$$\bar{x}_{es} = \frac{(L_1 + L_{2} + L_{3} + \cdots \dots \dots \dots \dots L_{n'})}{n}$$

For this formula, on days d_3, d_6, and d_9, $\bar{x}_{es}$ (TW)3, $\bar{x}_{es}$ (TW)6 and $\bar{x}_{es}$ (TW)9 represent the average weight loss rate per species at TW; $\bar{x}_{es}$ (BC)3, $\bar{x}_{es}$ (BC)6 and $\bar{x}_{es}$ (BC)9 represent respectively the average weight loss rate per species at BC.

Ln′ (TW) and Ln′ (BC) are the average rates of weight loss per species, where n′ represents the sample number.

The following formula is used to calculate Ln′:

$Ln' = 100 - ((Pd_{o+n} / Pd_o)*100)$

For Ln, Pd_o (TW) and Pd_o (BC) are the average control weights per species at TW and BC on day d_o.

Pd_{o+n} (TW) and Pd_{o+n} (BC) are the weights observed after 1 day to n days.

The denominator "n" in the fraction of the general formula for calculating $\bar{x}_{es}$ is an integer representing the number of observation days between d_o and d_9 at observation sites.

Microbiological analysis

The day after production (d1), the microbiological quality of "akpan" thus prepared was assessed. Mesophilic aerobic flora, total coliforms, *Escherichia coli*, sulfite-reducing anaerobic germs, *Salmonella* sp. and *Staphylococcus aureus* were sought and counted on a sample of cooked and unwrapped dough during cooking and serving as a control. Wrapped pieces of the "akpan" (tests) were also analyzed according to the categories of leaves and the producers. Five pieces was randomly selected by leave and by producer. 10g of each sample to be analyzed was added to a sterile bag containing 90ml of Tryptone Salt (TS). This mixture was homogenized using a stomacher to prepare the stock suspension with a titer 1/10 relative to the sample. It was left at room temperature for 45 minutes for resuscitation. The stock suspension was then subjected to a series of decimal dilutions by adding 1ml of this suspension or one of its dilutions to 9ml of TS. This hygienic quality control was repeated nine days (d10) after storage at laboratory room temperature. The microorganisms sought and the methods used are presented in Table 1.

Table 1. Microorganisms sought and analysis methods

N°	Microorganisms sought	Analysis methods	Culture media	Culture conditions
1	Mesophilic aerobic flora (total germs)	NF EN ISO 4833-1; September 2013	PCA	30°C, 24 to 72h
2	Total coliforms	NF EN ISO 4832; February 2006	VRBL	30°C, 24h
3	*Escherichia coli*	NF EN ISO 16649-2; April 2001	TBX	44°C, 24h
4	Sulfites-reducing anaerobes	NF EN ISO 15213; May 2003	TSN	44°C, 24 to 48h
5	*Salmonella* sp.	NF EN ISO 6579-1; April 2017	EPT/Rappaport/ Hektoen/SS/Kligler	37°C, 24h/culture media
6	*Staphylococcus aureus*	NF EN ISO 6888-1; August 2021	Baird Parker	37°C, 24 to 48h

RESULTS AND DISCUSSION

The production practices were carefully observed at every step while manufacturing "akpan" with the two producers. The research team observed the production stages from start to finish and provided, at times, assistance by scrupulously following the instructions given by the producers.

A B C

Fig. 3. Treatment of plants leaves before use (trimming of petioles A, cleaning of the leaves B and storage in a basket C)

Leaves handling before use

According to the two (02) producers, the leaves must be treated after purchase. The leaves are first cleaned with running water, then dried with a cloth and finally stacked by laying them flat in the open air, to always being stored in a basket until use (Fig. 3).

These technical information collected from them are corroborated by those collected during a parallel investigation carried out by our research team. This parallel survey was performed with a view to map the endogenous food production systems by describing the knowledge of the stakeholders and their different technological uses (Bahuchet, 2023). It revealed in Greater Lomé that, in order to prepare the leaves for use in wrapping "akpan", producers first cut off any remaining petioles. Then they wash these leaves with soapy water using a sponge or foam, rinse them in plain clean water or hot water. Lastly, producers dry the cleaned leaves in the open air in a basket or on a flat surface.

Corn-based cooked dough processing

Corn kernels preparation

According to the producers, corn kernels are generally purchased in markets. After removing the impurities, the grains are washed under running water and then, left to soak during 48 to 72 h. The soaking water was then discarded on the day of production, the corn kernels carefully washed in tap water and ground in a local mill. The flour thus obtained is then soaked in running water to prepare a dough which is cooked for 30 min over fire, stirred vigorously from time to time to prevent lumps forming (Fig. 4).

Fig. 4. Corn kernels preparation for "akpan" cooking (soaking and cleaning (A), milling (B), dough soaking (C), filtration (D) and cooking (E)

Wrapping process

To prepare the cooked corn dough's packaging, in the prepared leaves, the producers cut the leaves into two pieces to ensure a leak-free container of the food. Two plant leaf cutouts are used to wrap a piece of "akpan". One serves as a base and the other to provide the cover, the whole being wrapped with a regular and artistic method that is reproducible (Fig. 5).

Fig. 5. Cooked corn-based dough "akpan" wrapping method

Hygiene and manufacturing conditions

General food production conditions, particularly hygiene conditions, were also observed during direct observation. They differ drastically from one location to another. In the first case, the production site (TW) is the kitchen of the producer's place of residence, possibly accessible to anyone who wishes. The second production site (BC) is a small corner set up in a shanty town and very frequented by people who want to buy "akpan" or just need to make their way to their unsanitary place of residence. The producers and their assistants, if any, do not have special work clothes. The kitchen utensils and clothes were not specially maintained in a particular hygienic way as we observed. Nevertheless, an effort of cleanliness is noticed on the TW site as illustrated by the photos above.

Global technical discussion with producers

Discussing technological aspects with producers was not easy because their know-how was inherited through generations, which explains why each producer wants to keep a secret around information considered as professional secrets. It was necessary to explain to them that, by agreeing to share true and complete information, they contribute on the one hand to the practical training of students in vocational courses, and on the other hand, they would benefit from feedback allowing them to improve their own practices. This attempt to reassure them, certainly did not guarantee that all useful data could be made available for this study.

Processing diagrams elaborated for TW and BC locations

Two (02) processing diagrams (described below in Fig. 6 and 7) are elaborated according to all the experimental data (observations, note-taking and responses to questions) collected at TW and BC locations. Independently of the hygienic practices and the tools used, the production diagrams are almost identical.

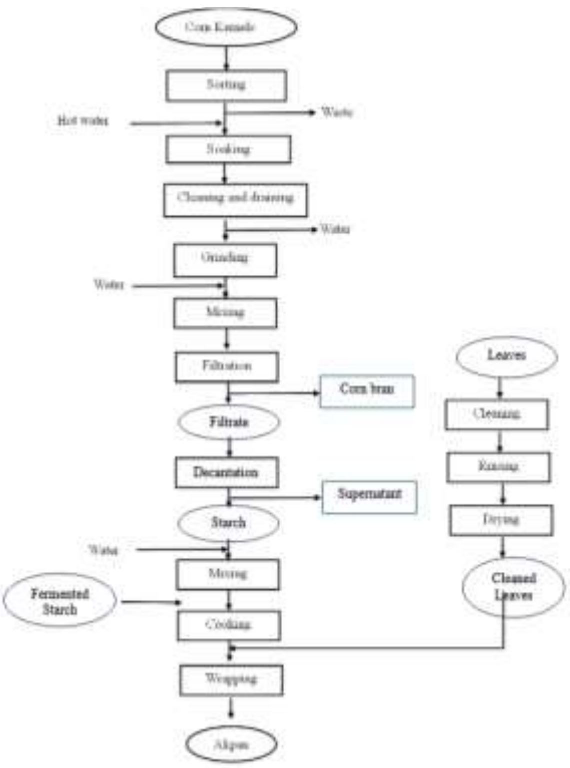

Fig. 6. Processing diagram at TW area

The traditional process of making corn-based dough called "akpan" can be broadly described in two main phases: the phase of preparing the vegetable wrapping leaves and the phase of preparing and cooking the corn dough.

Wrapping leaves treatment, as explained above, consists of a simple wash with water using a sponge, drying with a textile and then stacking for storage in a basket before use. This is already a very critical production condition at this stage because the occurrence of contamination is highly possible and due to raw material itself, processing material, environment, workforce, and processing method. The lack of control at this level endangers the health quality of the food, even if it is wrapped hot, and the safety of potential consumers, as no further step is available to mitigate such contamination (Ekpa *et al.*, 2019; Taylor *et al.*, 2022).

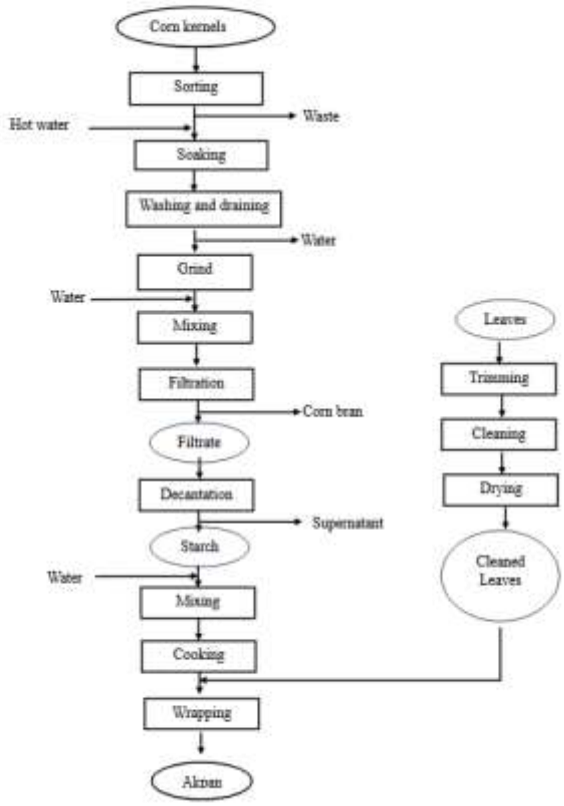

Fig. 7. Processing diagram at BC area

Quality of corn-based cooked dough "akpan"

Hygienic quality the day after production

The initial hygenic analysis results (d1) show unsurprisingly that the control sample of dough (ie non-wrapped, taken directly from the cooking pot at the end of the cooking process) is of satisfactory quality whatever the production site is (Table 2 and Table 3).

The conformity of the samples with respect to the criterion of mesophilic aerobic flora is satisfactory at site BC and better than that from site TW. All analyzed samples are free from *Salmonella* sp., *Staphylococcus aureus* and from sulfites-reducing anaerobes, whatever the production sites and the leaves types used for food wrapping. But it may not be the same for other types of contaminants.

At BC site, the samples are all exempt of *E. coli* whereas those from TW site wrapped with *M. mannii* and *M. cuspidata only* are contaminated, suggesting a fecal contamination linked with one to all production factors involved in food processing at TW site. The contamination by *E. coli* is corroborated by the presence of fecal coliforms in all samples produced on the TW site. These results are surprising at first glance, because from visual observation of the sites, TW appeared cleaner than BC. This fact confirms that environmental cleanliness is not enough to guarantee the overall hygienic quality of the food. The danger certainly does not come from the dough since the controls are all of satisfactory quality. It is thus, probably a combination of one or more factors, such as leaves, people, environment, kitchen ustensils and/or processing method itself. Further analysis of the process diagrams would help identify critical points for control.

Table 2. Initial hygienic quality of samples produced at TW site

Leaves species	TW (d1*)					
	Mesophilic aerobic flora	Total coliforms	*Escherichia coli*	Sulfites-reducing anaerobes	*Salmonella* sp.	*Staphylococcus aureus*
Control indicators	< 300 000 UFC	< 1 000 UFC	< 10 UFC	0 UFC	0/25	< 100 UFC
M. mannii	276 400	2 420	104	0	0	0
M. cuspidata	374 000	5 298	1 444	0	0	0
M. purpurea	186 640	2 796	0	0	0	0
Control	500	50	0	0	0	0

(*) d1: sampling occurred for analysis the day after production day

Table 3. Initial hygienic quality of samples produced at BC site

Leaves species	BC (d1*)					
	Mesophilic aerobic flora	Total coliforms	*Escherichia coli*	Sulfites-reducing anaerobes	*Salmonella* sp.	*Staphylococcus aureus*
Control indicators	< 300 000 UFC	< 1 000 UFC	< 10 UFC	0 UFC	0/25	< 100 UFC
M. mannii	25 900	50	0	0	0	0
M. cuspidata	127 500	0	0	0	0	0
M. purpurea	7 700	50	0	0	0	0
Control	83 000	50	0	0	0	0

(*) d1: sampling occurred for analysis the day after production day

(A) (B) (C)

Fig. 8. Visual appearance of "akpan" pieces (wrapped with A: *M. mannii* – B: *M. cuspidata* – C: *M. purpurea*) after three (3) days of storage

Global quality nine (9) days after storage

Microorganisms' development on the leaves packaging: The "akpan" samples kept at laboratory room temperature deteriorated more or less quickly.First of all, a development of more or less orange-colored microorganisms appeared after three (3) days of storage, as shown in the photos below.

An attempt to identify these microorganisms was made under a microscope after mounting between slide and coverslip as shown below (Fig. 9).

Fig. 9. Sampling and mounting of microorganisms between slide and coverslip

The microscopic description of the microorganisms revealed five types of structures, namely pseudo mycelium, septate mycelium, numerous blastospores, some of which are budding, rare terminal chlamydospores and dichotomous ramifications. This details cannot be illustrated here due to the lack of a microscope equipped with a camera. Only the observations of the handler confirmed by a mycologist are authoritative.

This early deterioration of the products contradicts the conservation forecasts announced by the processors. According to the responses given during impromptu interviews at the production workshop, the average shelf life of "akpan" is 7 days and can go up to 10 days in the open air in their kitchens. This suggests that the storage conditions in the laboratory certainly contributed to this early deterioration. Indeed, the laboratory windows remained closed all day long and no air current was possible for reasons of protection against surrounding pests.

Weight loss: Akpan pieces experienced a gradual weight loss during the storage period. This parameter is calculated by the formula describe in the methodology. Table 4 illustrates this phenomenon.

Table 4. Weight loss rate of "akpan " samples during storage

Leaves species	TW				BC			
	Weight loss rate (%)				Weight loss rate (%)			
	J0 - J3	J3 - J6	J6 - J9	J0 - J9	J0 - J3	J3 - J6	J6 - J9	J0 – J9
M. purpurea	2.89	3.45	3.18	9,52	2,82	5,36	4,60	12.78
M. mannii	2.18	0.71	5.90	8,79	2,34	5,30	7,35	14,99
M. cuspidata	1.22	1.58	7.26	10,06	2,88	5,26	4,36	12,5

Table 5. Final hygienic quality of samples produced at TW site

Leaves species	TW (d10*)					
	Mesophilic aerobic flora	Total coliforms	*Escherichia coli*	Sulfites-reducing anaerobes	*Salmonella* sp.	*Staphylococcus aureus*
Control indicators	< 300 000 UFC	< 1 000 UFC	< 10 UFC	0 UFC	0/25	< 100 UFC
M. mannii	1 669 000	1 434	522	0	0	0
M. cuspidata	5 308 000	4 186	400	0	0	0
M. purpurea	2 058 000	1 554	0	0	0	0

(*) d10: sampling occurred for analysis nine (9) days after production day

Overall, the data show that all the preserved "akpan" samples lost mass during the storage period, regardless of the plant species used for packaging. This fact is probably the consequence of evaporation which seems to be more important (11.06 %) with *M. cuspidata* leaves as packaging. Only the TW data could be used for this hypothesis because the “akpan” pieces from the BC site deteriorated very quickly, in an anarchic manner and did not allow measurements after 3 days of storage. Overall, foods retain their firm texture up to the third day. Those from BC deteriorate more quickly than those from TW. This situation could be explained by liquid loss and germs attack.

Table 6. Final hygienic quality of samples produced at BC site

Leaves species	BC (d10*)					
	Mesophilic aerobic flora	Total coliforms	*Escherichia coli*	Sulfites-reducing anaerobes	*Salmonella* sp.	*Staphylococcus aureus*
Control indicators	< 300 000 UFC	< 1 000 UFC	< 10 UFC	0 UFC	0/25	< 100 UFC
M. mannii	2 000 000	1400	0	0	0	0
M. cuspidata	-	-	-	-	-	-
M. purpurea	-	-	-	-	-	-

(*) d10 : sampling occurred for analysis nine (9) days after production day

Hygienic quality 9 days (d10) after production

The final hygenic analysis results nine (9) days after production are described by Table 5 and Table 6 below. TW site products have unacceptable quality with germ counts that have increased exponentially regardless of the type of plant species used for packaging. The tendency for contamination by *E. coli*, and the absence of sulfite-reducing anaerobes, *Staphylococcus aureus* and *Salmonella* sp. remains the same.

The hygienic quality of the food from the BC site after 9 days of storage could not be assessed due to a lack of samples. The massive deterioration was more pronounced in this batch. However, massive development of mesophilic anaerobic flora (25900 to 2.10^6) and Total coliforms (25 to 10^2) should be noted with samples wrapped in *M. mannii.*

DISCUSSION

The traditional production of "akpan" dough packaged with *M. cuspidata*, *M. purpurea* and *M. mannii* is a contributing factor to the promotion of local consumption, cultural heritage and national economy growth of Togo and other countries (Kamda *et al.*, 2024; Owolabi *et al.*, 2023). From a nutritional point of view, this form of packaging can promote the migration of nutrients to the food and even strengthen its protection against contamination, rapid decomposition, coloration, pea loss and the release of unpleasant odors (Barone *et al.*, 2021; Kora, 2019). In the medium and long term, the adoption of the packaging of "akpan" pulp from leaves of plant species will undeniably constitute a source of reduction in the production of plastic waste, the use of plastic materials currently taking precedence over that of sheets in the endogenous packaging processes of said dish. In addition, the acceptance and adherence of producers and consumers to this form of local food packaging can help avoid the consequences of ecological degradation resulting from the excessive use of plastics (Tang and Pashkevich). Indeed, as the leaves are biodegradable, they can quickly degrade naturally. Preventing soil compaction is a tangible implication that can improve its structure. Furthermore, these leaves, in this degradation process, are a source of fertility for agricultural soils due to their ability to restore key nutrients (phosphorus, potassium, nitrogen) and to reconstitute humus favoring the retention of these nutrients in the soil. The use and proper recycling of these plant species can therefore be included in organic agricultural production systems (Emami *et al.*, 2025). This potentially contributes to reducing the pollution of surface water sources from chemical inputs often misused by producers (Ezeudu *et al.*, 2021; Tirpude and Singh, 2025). The packaging of "akpan" paste from plant leaves is also a significant indirect factor in reducing the risks of parasitic, microbial and viral contamination that can result from the accumulation of plastic waste in landfills and near homes. This endogenous perspective of packaging "akpan" pulp indirectly reveals itself as a considerable determinant in the reduction of public health expenditure (Kamda *et al.*, 2024). The production of greenhouse gases generated by plastic waste would also be reduced and could play a significant role in slowing the degradation of the ozone layer and reducing global warming.

The contamination of all TW samples observed by *E. coli*, although surprising, may originate from production utensils or various handling procedures carried out by producers during processing or packaging (Ekici and Dümen, 2019). In individuals with fragile health or immunity, hemolytic or uremic syndrome may even arise with clinical complications that can be difficult to control (Schirone and Paparella, 2025).

From a micro-organic perspective, pseudo-mycelia can cause digestive or systemic candidiasis in people with weak immune systems. Septate mycelia, for their part, can even lead to consumers contracting hepatotoxic or carcinogenic diseases. In other cases, allergic reactions of varying degrees may occur depending on the patient's organism. The possible consequences of the observed results are not insignificant. The producers surveyed are processors who produce in bulk and supply retailers. *E. coli* can poison the end consumer and cause diarrhea, abdominal cramps, nausea, and even vomiting, with varying degrees of severity depending on the individual and the level of contamination (Brito-Junior *et al.*, 2025; Schirone and Paparella, 2025). If these wholesale processors supply several “akpan” retailers in many communities in various event contexts, this indirectly raises a public health issue. Undeniably, these facts can affect consumers' quality of life. Instead of spending their income on other items, consumers run the high risk of spending it on unexpected health problems related to the consumption of contaminated food. This food, consumed every day by thousands of people in Greater Lomé, highlights the need to strengthen public community systems for monitoring and controlling food hygiene wherever they may be. The presence of *Neurospora* fungi could lead to the appearance and proliferation of other molds (Brito-Junior *et al.*, 2025; Ogwu and Ogunsola, 2024). The observed fungi appear to be of the genus *Neurospora*, probably species *N. sitophila*, *N. crassa*, *and N. tetrasperma*. Further study would help refine this identification. These species are known to typically grow on cereals, bread, dead plant material, and fruit (Kuo *et al.*, 2017).

They can cause changes in the pH of food, spoil its taste, and even degrade nutrients such as carbohydrates. The color, smell, and texture of the food may be altered depending on the level of contamination. While this mold does not pose a significant risk to healthy eating, it can cause respiratory allergies when handled or lead to food contamination and consumer poisoning from potentially pathogenic bacteria. But at this level, food losses are the most significant problem (Ndudi *et al.*, 2024). Not only can these losses be quantified in economic terms, but also in nutritional terms. The amount of carbohydrates and minerals lost due to the deterioration of the dough in question poses nutritional challenges for the municipalities of Greater Lomé.

In sum, the packaging of the "akpan" paste from *M. cuspidata*, *M. purpurea* and *M. mannii* has nutritional, ecological, cultural, health, even economic advantages. But non-compliance with hygiene rules can undermine the nutritional and health potential of this practice due to the risks of contamination associated with it apart from the absence of analyzed contaminants.

CONCLUSION

Packaging “akpan” dough with *M. mannii*, *M. purpurea*, and *M. cuspidata* protect it from contamination by microorganisms that can destroy its nutritional content, its texture, smell, or color. This technique is also used to transport the dough from one location to another over long distances for several days. The packaging of “akpan” in Greater Lomé using plant species, beyond the advantages above mentioned presents several challenges. At both observation sites, *E. coli*-type coliform bacteria were found in the packaged dough. These germs can cause gastrointestinal infections in consumers, depending on the organism and the level of contamination, and therefore pose a public health problem. The *Neurospora* mold observed can cause the appearance of other contaminating organisms that can poison consumers. They are also a sign of nutritional degradation of the food. The same is true for the texture, color, and smell of the paste. The deterioration of these qualities, regardless of the species observed, was highlighted by the gradual loss of weight of the dough from the first to the tenth day of observation. The problem of food weight loss observed, even though the research did not focus on it, is surely accompanied by a certain loss of macronutrient and micronutrient consumption that people have failed to consume. These results have led to the development of technical innovation projects based on endogenous knowledge regarding the healthy packaging of “akpan” from the targeted plant species. Mastering and controlling manufacturing diagrams and critical points could lead to better quality results. Nutritional quality must also be monitored to see how it changes over time during storage, for example.

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