

## A Case Study to Develop an Appropriate Quality Assurance System for Two Cassava-based Convenience Foods in Ghana

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**Abstract:** Over the last few years, there has been an increased interest in the production of cassava-based convenience foods for the urban markets in West Africa. Most consumers want to be assured of the quality and safety of these products. This paper reports on a case study, involving two food industries, to develop an appropriate quality assurance for two popular cassava-based convenience foods in Ghana, *fufu* and *kokonte* flour. Based on the HACCP principle, the pre-requisite programmes of the two companies were first assessed, HACCP teams were constituted, flow diagrams constructed and verified, critical control points with accompanying critical limits, monitoring procedures, corrective actions, verification procedures, record keeping and documentation procedures were established. The paper finally highlights some difficulties that potential cassava-based factories might face in ensuring safe and quality products.

**Key Words:** Cassava-based food products, *fufu* flour, *kokonte* flour, food safety, HACCP.

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### Introduction

In West Africa, two popular traditional cassava-based staple foods are pounded *fufu* and *kokonte*. In response to growing demand by working families as well as for export, convenience forms of these two cassava-based products are increasingly being produced by a number of small and medium-scale food industries in Ghana. To meet the requirements of the World Trade Organization's (WTO) sanitary and phytosanitary (SPS) agreement, a number of these food industries have taken steps to improve upon the safety and quality management systems for these two products.

The SPS agreement recognizes the role of food safety system based on the principles of the hazard analysis critical control points (HACCP) (Codex Alimentarius Comm, 1997). A necessary condition for the use of this principle, by any food factory, is that a full operational pre-requisite programme must be in place. This is a case study, carried out from 2004 to 2006, to develop appropriate quality assurance systems for *fufu* flour and *kokonte* flour produced by two Accra-based food companies, Company A and Company B.

### Experimental

#### Baseline Audit

Baseline audits of the pre-requisite programmes for the implementation of HACCP were carried over a period of one month for each of the companies using the methods of Dillon and Griffith (1997). The ten pre-requisite programmes assessed were the structure and fabrication, storage facilities, raw materials, process equipment, personnel standards, food handling practices, quality assurance, pest prevention, cleaning systems and management control. Each programme had ten sub-programmes

expected to be satisfactorily performed by the company. A 5 point scoring system, starting from “not performed” to “very well performed” was used. As part of the assessment, samples of raw materials, in-process materials as well as finished products were taken and analysed at the microbiology and chemistry laboratories of the Food Research Institute of Ghana. A report on non-compliances identified and the recommended corrective actions was prepared for implementation by each company.

**Preliminary steps for HACCP Implementation**

The HACCP implementation was carried out a year after the baseline audits, after the two companies have had the chance to correct most of the non-compliances identified during the baseline audit. The HACCP system was based on the methods by the Codex Alimentarius (Cassani & Knochel, 2002). To start it all, a HACCP team was first constituted for each factory. Each team was made of the production and quality control managers, three production supervisors, purchasing officer and the cleaner. Several sessions were held with these teams to explain the principles and methods used in HACCP systems. The expected role of each member of team in the HACCP implementation programme was carefully explained. For each product, a full description and its intended use were documented together with team. Next, the terms of reference of the management of the two companies in respect of the HACCP systems were fully defined.

**HACCP Steps**

*Hazard Analysis*

Hazard identification implies listing of the hazards of potential significance. For inclusion in this list, the hazard must be of such a nature that the prevention, elimination or reduction of these to acceptable levels is essential to the production of a safe product (Cassani & Knochel 2002).

*Establishing Critical Control Points (CCPs)*

The HACCP implementation began with construction of the process flow diagrams (PFDs) of the two products with the teams, followed by on-site verification of the PFDs. During this exercise, and for each process step, all potential hazards, their sources and possible control measures were discussed and documented in the form of worksheets. The hazard analysis included any previous reports the two factories had earlier regarding safety of their products, recall of products as well as results of the analysis carried out on samples taken during the baseline audit. The critical control points (CCPs) were then established using

the Codex decision tree (Codex Alimentarius 1997). Critical limits and monitoring procedures for each of these limits were then established. Corrective actions that need to be undertaken in the event of something going wrong and verification procedures were established. Finally, the type and procedures for record keeping and documentation were established.

*Establishing Standard Operating Procedures and Quality Manual*

To assist proper monitoring, the HACCP teams in the two companies were assisted to draw up standards operating procedures and working instructions for production staff for the main processing sections. These were boldly written printed in the form of posters mounted at the various sections. In addition, the HACCP team were assisted to identify and list out laboratory analyses that need to be undertaken periodically to verify the quality and safety of two products. All these were documented in a quality manual.

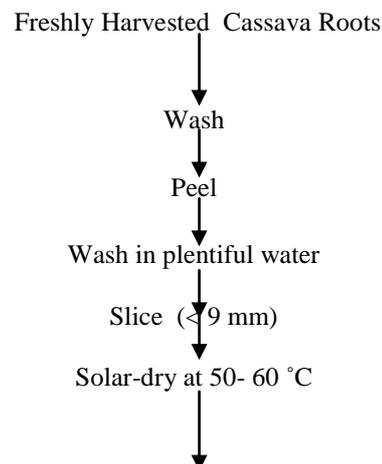
*Instituting Internal Audit Scheme*

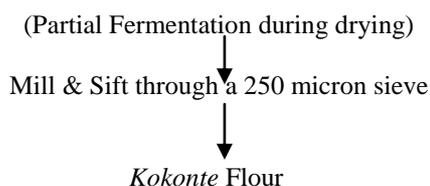
To assist periodic monitoring of the HACCP Plan, the managements of the two companies were also introduced to the principles and procedures for internal auditing. Two of such internal audits were carried out with the companies during the two-year period during the implementation of the HACCP plans.

**Results and Discussion**

*Description of Products and Intended Use*

*Fufu flour* is a convenience form of pounded fufu, made from cassava and either plantain or cocoyam or yam flour (Johnson, *et al* 2006a). Its moisture content is 6 % (w/w) and has a stable shelf life of 1.5 -2 years. It is made into a thick paste by adding boiling water and eaten immediately with soup.





*Kokonte Flour* (Fig 1) is made from partially-fermented cassava chips, sun/solar-dried and milled into flour. Its moisture content (6 % w/w), pH 4.6, shelf-stable (1.5 – 2 years) and used as in *fufu* flour.

*Hazards, Critical Control Points (CCPs), Critical Limits and Monitoring Procedures*

**Table 1:** Types, sources of hazards, control measures and monitoring procedures for identified CCPs during production of cassava- plantain *Fufu* flour.

Process step	Hazards & Sources	Critical Limits & Control Measures	Monitoring
Washing of raw materials CCP	Pathogens e.g <i>E. coli</i> , <i>Salmonella</i> , <i>Vibrio cholerae</i> , Fungal spores. water from storage tank	Treat storage water with chlorine	Use of microbiological kits
Drying CCP	Pathogenic bacteria. If dryer temperature is low.	Temperature: 55 - 65°C	
Cleaning CCP	Spoilage & pathogenic organisms. Spent water	Clean premises, processing equipment, GHP & GMP	Visual inspection. Cleaning records

**Table 2:** Types, sources of hazards, control measures and monitoring procedures for identified CCPs during production of *kokonte* flour.

Process step	Hazards & Sources	Critical Limits & Control Measures	Monitoring
Washing of raw materials CCP	Pathogens e.g <i>E. coli</i> , <i>Salmonella</i> , <i>Vibrio cholerae</i> ,Fungal spores . water from storage tank	Treat storage water with chlorine	Use of microbiologic al kits
Partial Fermentation CCP	Spoilage & pathogenic organisms	Correct fermentation time Cover the fermenting chips	Cooking temperature and time, , water quality
Solar drying CCP	Aflatoxins; due to inadequate/ prolonged drying due to bad weather	..... ppm chip thickness < 7mm Temperature > 50 °C mm	Analyze for aflatoxins with kit
Cleaning CCP	Spoilage & pathogenic organisms.	Clean premises, processing equipment, GHP & GMP	Visual inspection. Cleaning records

Tables 1 and 2 highlight the main processing steps with CCPs, the critical limits, control measures and monitoring procedures for the two products.

Additional critical limits that should be observed are that the cassava to be processed must have been harvested the same day. Water used for washing the cassava slices should be colourless, odourless and neutral to taste. For the *kokonte* flour, the size of cassava slices should not exceed 9 mm. This was to ensure that complete drying of the cassava slices occurred within the shortest possible time. This will help to prevent the development moulds which could lead to the development of aflatoxin. Ainoa Awua *et al* (1998) have explained additional housekeeping practices that need to be enforced to help ensure that the processing plant and processing areas are clean at all times. The HACCP Implementation required that there should be periodic sampling of the products from identified CCPs as well as from final products for microbiological and chemical analysis by an approved laboratory. This is for especially for *kokonte* flour which from previous evidence showed the tendency to become mouldy and therefore the possibility of the presence of aflatoxins, brown and attacked by weevils (Johnson, *et al* 2006b) . One major problem with this is that the number of food analytical laboratories in Ghana is rather low. The high cost of services and the slow delivery time are major worrying factors for the food manufacturing companies in Ghana. These few laboratories are also constrained by the lack of requisite and modern equipment. Analytical chemicals are normally hard to come by. Presently, none of laboratories have been accredited to international standards, meaning that analytical results from any of them may not be acceptable for export trade purpose in several countries.

To assist the production manager, Standard Operating Procedures (SOPs) were developed for the various key processing sections to ensure regular compliance to the HACCP Plan. Table 3 gives that for the *kokonte* flour.

**Table 3: Standard Operating Procedure Developed for the Production of Kokonte Flour**

Process step	Standard operating procedures
Washing	1. Wear gloves, nose mask and head gear, 2. Wash bowls thoroughly, 3. Use clean water.
Slice	1. Clean the slicer, 2. Remove the 3 components of slicer and clean,3. Check sharpness of blade. 4. Fix back dismantled parts. 5. Check on movement of belt.6. Power check. 7. Introduce product
Ferment	1. Wear gloves, nose mask and head gear, 2. Use clean water and bowls.3. Cover bowl with nets. 4. Check daily.
Drying)	1. Wear gloves, nose mask and head gear. 2. Clean trays (clean water/ metabisulphite). 3. Allow trays to dry. 4. Put trays into dryers. 5. Set into 70°C . 6. Check after 7 hours
Milling	1. Wear gloves, nose mask and headgear. 2. Clean filters

	before and after milling. 3. Clean the receptacle. 4. Clean sifters, blades and hammers 5. Test-run machine. 6. Replace filters. 7. Introduce product.
Cleaning	1. Use of Cleaning In Process system(CIP). 2. Use of food-grade sanitizing washing soap for each time 3. Use clean water .

Table 3 highlights a number of key requirements for ensuring safety of the products. Some of these have bearing on the type of plant and machinery, equipment and tools used for processing. It is a requirement that all contact areas for food in processing equipment must be made of stainless steel. Unfortunately, in Ghana stainless steel is not easily available, but also very costly. Even when this is available, those selling them are unable to give the correct specification on gauge, size and materials' strength. This is one major worry for the design engineer. The qualities of fabricated machines, like stainless steel slicers, dryers and milling machines in the case of the two products under study, are therefore low leading to frequent breakdown. And because the parts and tools also not standardized, the downtimes of most the processing machines are long (Johnson, 2002). Unfortunately, most commercial banks are not too willing to give concessionary medium to long-term loans to micro- and small-scale food producing companies. The high rate of interest for short-term loans that are offered is too risky for most entrepreneurs. Thus, they are unable to source funds to buy required plants and machinery for improving their working facilities; all of which would have helped the companies to ensure good manufacturing and hygienic practices and thus continued implementation of the HACCP plans.

### Conclusions

This case-study has demonstrated that the food safety management system based on the HACCP principles is applicable to the production of two popular cassava-based convenience food products, *fufu* and *kokonte* flour, in Ghana. However continued and effective use of the HACCP Plans is contingent on addressing some of the constraints facing the food industry in Ghana.

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