Sustainability of Garri Processing: A Case Study of Ogun State, Nigeria

A U Samuel 1*, E T Akinlabi 2, I. P. Okokpujie 1, O.S.I. Fayomi 1

1Department of Mechanical Engineering, Covenant University, Ota, Ogun State, Nigeria
2Department of Mechanical Engineering Science, University of Johannesburg, South Africa
*Corresponding emails: ayubasushe@gmail.com, ayubasushe@yahoo.com ayuba.samuelpgs@stu.cu.edu.ng

Abstract. Garri is one of the most developed and convenient staple food commodities been produced from cassava in West Africa. To select the best method, garri production technology has been manufactured at different levels, this includes grating, fermentation, and dewatering. Producer of garri and edible starch is faced with the problem of the product price, limited information, and inadequate capital, lack of equipment, poor road, inadequate labour and water supply, long waiting time during grating, and some stages of processing. Limitation experienced by cassava processor includes lack of capital, inadequate power supply, the short lifespan of raw cassava tuber, long fermentation process, high cost of transportation, unstable price of garri. Result obtained from the constraints limiting garri processing in owode-yewa of Ogun state revealed that the short life span of raw cassava tubers is the most severe with 98%. This rating was followed by the unstable price of garri with 92%, long fermentation process with 67%, high transportation cost of inputs with 63%, while the lowest is the lack of access to information with an 8% plant layout. This study was able to provide scheduling operation of garri processing, the process of operation, maintenance of operation, plant layout, and come up with results that can be useful for other processing units in other countries.

Keywords: Garri, Limitation, Plant layout, Scheduling

1. Introduction

Garri is an affordable substitute for most of the carbohydrate food in Nigeria [1]. It is manufactured as a staple food that is consumed in Brazil and most African countries, especially in Nigeria, where most of its preparations are made using local processing techniques [2]. To ensure its circulation, there is a need for massive production, processing, utilization, and storage. Garri is the most developed, convenient staple food and storable commodity been produced from cassava in West Africa. It is consumed with sauce when processed or mixed with hot water to give "Eba," which is consumed with sauce. To select the best method, garri production technology has been manufactured at different levels, which include root grating, fermentation, and dewatering [3]. Garri, which is produced from cassava, tuberous roots with thick skin, is a fine grain that can be made into bread and crackers [4]. To obtain the final product, six traditional processing steps that will be involved are peeling, washing, grating, drying, sifting, and frying [5]. Garri is characterized by faintly flavour, sour taste, which is due to the fermentation of new cassava tubers [5]. Lack of equipment, poor road, inadequate labour and water supply, absence of good roads were the major challenges of garri production. Mechanization of cassava processing operations has contributed towards improving human capacity leading to a rise in production.

For many years, there have been findings into mechanization techniques involving unit operations of peeling and washing of tubers, grating, dewatering, fermentation, sieving, frying, and cooling where garri production will be done [6]. Mechanizing this operation entirely created severe challenges to many designers and manufacturers. Garri has become a significant staple food for many households. In Nigeria, garri processing been practiced for several decades has been known to occupy a considerable portion of small and medium enterprises that have contributed significantly to national
economic growth [7]. Several years ago, women fried garri in shallow earthen-ware cast-iron pans over a wood fire using spatula-like paddles of wood and press the sieved mash against the hot surface of the frying pan, while turning endlessly to prevent cake production [8]. This has made researchers be inspired towards solving the challenges of heat produced from the wood fire been faced by the operator. In Nigeria, quality mechanized garri processing plants are few, and as a result, researchers in Nigeria are seeking advancement in already existing models [9]. According to [10], garri is consumed by most people, especially in the West Africa sub-region. He further stated its method of processing, which is from peeling to roasting. It is a granulated, white, or yellowish product which is dependent on the production methods.

This study examined the factors limiting the processing of cassava tubers to garri, which happens to be one of the staples in Nigeria and some other African countries. Specifically, this study will help to provide information at each stage of processing, identify, and quantify the factors that will influence the economy. This study was able to come up with results that will be useful for other processing units in other countries.

2. Sustainability, limitation, and findings on the production of garri from cassava

Cassava processing has been limited by inadequate constant supply all through the year, high cost of moving to process centers, lack of equipment. Several kinds of cassava processing machines been produced locally have minimal efficiency, and they include cassava grater, sifter, watering press, Garri fryers, cassava chippers, batch dryer, pelleting machines, and cassava starch mill [7]. Recent cassava processing operations have been discovered by most of the researcher to labour intensify where the women and children play a vital role in production [6]. Furthermore, challenges of labour-intensive noticed with peeling, grating, milling, dewatering, toasting, sifting, etc. have been mostly from Poor quality of locally produced cassava products. It takes a long time of an average of 90 hours to process 100 kg of Garri per person. The majority of cassava processing machinery is expensive, and as a result, acquiring the readily available machinery constitutes a significant problem. Furthermore, low capital investment of the peasant processors makes them form cooperative bodies that will enable them to buy machinery they lacked, which cannot be owned by a person [3]. Manufacturers of garri and edible starch are faced with the challenge of seasonal variations in the prices of the product.

Table 1 shows that the assessed result of limitation been experienced by cassava processors in owode-yewa are of Ogun state Nigeria. Furthermore, these include lack of capital, inadequate power supply, the short lifespan of raw cassava tuber, long fermentation process, high cost of transportation, unstable price of garri.

| Constraints                                      | Most severe (%) | Less severe (%) | Not at all (%) |
|--------------------------------------------------|-----------------|----------------|---------------|
| The short life span of raw cassava tubers         | 98              | 0.96           | 0             |
| Unstable price of garri                          | 92              | 0              | 0             |
| Long fermentation process                        | 67              | 6.8            | 4.85          |
| Lack of capital                                  | 60              | 1.9            | 0             |
| Inadequate power supply                          | 53              | 10.6           | 12            |
| High transportation cost to the sales point       | 52              | 3.9            | 0             |
| Poor accessible road                              | 13              | 18.5           | 22            |
The result of this limitation carried out revealed that the short life span of raw cassava tubers is the most serious with 98%. This rating was followed by the unstable price of garri with 92%, long fermentation process with 67%, High transportation cost of inputs with 63%, while the lowest is the lack of access to information with 8%. The purpose of this survey is to determine the most severe factor during production and suggest way out to boost the productivity of garri.

Figure 1 shows the plant layout of the garri processing firm in owode-yewa of Ogun State Nigeria, which is divided into two sections (wet and dry area). When the moisture is still present during the process, it is regarded to be in the wet area, but when moisture is reduced to a certain percentage, it is regarded to be in a dry area. It comprises of the toilet for staff, the shed for the peeling of cassava tubers and washing, water thoroughly to channel water for use, the grating compartment, fermentation compartment where it is left to ferment, and then pressed using a pressing machine. After this highlighted process from the layout, it is then channelled to the dryer than to the milling section for grinding and then sieving. The last phase is the frying section before been cooled and the move to the store located at the bottom right section of the layout.

Figure 1. Plant layout of garri processing firm in Owode-yewa Ogun State [23].
2.1. Findings on garri production in areas of case study
A sum of ten processing centres were examined in Owode-yewa of Ogun state in Nigeria. Most of the processors have more than one machine. A total of hundred machines were examined. A glance shows that grater with the highest efficiency of 70% was widely accepted. It was accepted when the price of garri was not stable. The processors accepted dewatering and milling machine with efficiency of 46.9% and 40% when the price of garri was stable. Findings also revealed that 85% of the machines used for garri processing were manufacture by artisans who have sparse or zero information on material strength, and the could be a limitation on the operational performance of these machines since material design input is lacking.

3. Processing stages from cassava to garri and maintenance operation
The basic processes of peeling, grating, pressing, sieving, and toasting are considered in the scheduling operation in Figure 2. Thus, customers from all over the environs arrive at different periods of the day with different quantities of fresh cassava roots for processing. The collected fresh cassava is first and foremost weighed by the firm, which then moves to the peeling section after been peeled. It is grated and then pressed against the sieve using a sieving machine to remove the moisture content [11]. The final stage is where is fried using the frying machine or the toasting machine and then cooled before packaging for sales for people in the owode-yewa area of Ogun state and its environs.

To obtain maximum profit, customer scheduling is very crucial. The principles are regarded as a flow shop technique where customers can bring their fresh cassava at any period. Moreover, individual customer's fresh roots order goes through the machines in the same order. Since different amounts of fresh roots cassava are brought for processing and each of these fresh roots might have a different surface area which will require different amounts of processing time.

![Figure 2. Scheduling operation of garri processing firm [22]](image)
The processing stages of cassava into garri include peeling, washing, grating, dewatering, sieving, frying, cooling and packaging [12-15]

- **Peeling**: After harvesting, cassava roots are peeled immediately to prevent the appearance of peel in the final product. The main essence of this first step is to remove the brown peel, which can influence the colour content of the final product [14-17].
- **Washing**: To remove dirt, peeled roots are washed thoroughly in water [13].
- **Grating**: This process is done by using either motorized cassava or machine or hand graters. It consists of a perforated metal sheet and with a sharp extruding face at the grating zone [18-20].
- **Fermentation**: This process involves leaving the grated cassava mash in moisture for between 1 and 5 days to ferment. The preference of garri is to its sourness, which has to do with the quantity of lactic acid or period of fermentation [21].
- **Dewatering**: The cassava mash been fermented is dewatered by pressing a machine whose fundamental purpose is to minimize the moisture content in the grated mash to minimum%. This operation removes cyanogen’s, cyanohydrins together with the waste liquor. For proper dextrinization during roasting, dewatering is crucial [19].
- **Sieving**: Lumps formation is minimized during frying by sieving [23].
- **Roasting**: This process is done immediately after sieving. The utilization of mechanical fryers has become very rampant in Nigeria. The first stage is dextrinization, followed by drying. The turning of garri, during roasting, is continuous and gives room for proper gelatinization to occur. The flavour of garri becomes strong during this stage, thereby improving the digestibility. At this stage, the final moisture content of gari is below 10% [22-24].
- **Cooling and packaging**: As the garri cools, it becomes drier and more durable. After cooling, the final product is packaged for distribution to the outlet. Garri can be preserved for a minimum of one year if it is appropriately packaged under the conditions of ensuring the polyethylene lining is not broken [25-27].

### 3.1. Maintenance operation

Cassava processing equipment requires series of maintenance to provide continues operation. Cassava grating, mechanical dewatering and frying machine must be constantly maintained to down time that could result from incessant breakdown of equipment.

- **Cassava grating machines**: Brushes should be used to clean off residues of cassava from the outlet, hopper, and other components of the machine to prevent blockage. The grating compartments should be disassembled at the close of daily operation to remove all residues and allow to before reassembling. Engine motor and other electrical components should be safeguard from moisture [28].
- **Mechanical dewatering machines**: The bottom and upper plates of this machines should be clean with brush with water and soap to eliminate stuck starch, and other residue of cassava. Hot water should be Spray to rinse off greasy soapy water having residue from surfaces [15].
- **Frying machine**: The inside of the roasting pans should be clean with soap and water and then dry with towel or clean cloth material. Components of the machine such as the electric motor should be checked daily. Electrical part of the machine should be kept from moisture to prevent shock. The frying pan should be clean daily after use and must also be clean before usage to avoid the mixing of dirt with garri [2, 29].

### 4. Conclusions and recommendations

Processing of cassava either for industrial or domestic usage has to do with different operations. Garri processing is a viable product that will boost food production thereby minimizing poverty if manage well. It can add value to Gross Domestic Product (GDP) and provides employment opportunities for the people. Adequate efforts should therefore be made in making modern processing equipment ease
processing process. The government should play a major part by providing good storage facilities and good road network to channel and transport this product to. Findings from the study have also showed that processing and marketing of garri, is a profitable enterprise. Therefore, there is need to increase cassava processing and enlarge the industry for opportunities.

To enhance the standard of living of rural processors to utilize machines using electricity and diesel, provision of basic infrastructure is required. Government and companies using processing machines should provide the necessary help towards the commercialization of cassava processing machinery to be available to processors at subsidized rate educate the farmer using an appropriate extension system.

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