

**THE NEED FOR ADOPTION OF IMPROVED TECHNOLOGIES
TO ADDRESS CHALLENGES IN
SMALL-SCALE CASSAVA PROCESSING IN GHANA**

Amoah F^{1,2*}, Akowuah JO² and EYH Bobobee²



Francis Amoah

*Corresponding author email: famoah2020@yahoo.com

¹Department of Agricultural Engineering, Ho Technical University, Ho, Ghana

²Department of Agricultural and Biosystems Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana



ABSTRACT

The cassava processing industry in Ghana is dominated by small-scale processors who contribute valuably in terms of processed products such as *gari*, cassava flour, and cassava dough, among others, and as a result play a major role in the postharvest food system of the country. Their activities depend mostly on traditional methods of processing which have limitations in relation to the quality and quantity of the processed cassava products. They also rely mostly on manual labour which can be slow, costly or unavailable. Mechanisation of key operations in cassava processing activities has been identified as a means of increasing production, reducing postharvest losses as well as saving time. This study sought to assess the need for adoption of interventions to address challenges encountered during processing of cassava into a local staple known as *gari* (roasted fermented cassava grits). Cassava processors in selected parts of Ashanti and Bono East regions of Ghana were involved in the study. Focus group discussions and semi-structured questionnaires were employed for data collection. Results show that the main technological interventions used by small-scale processors in *gari* production are the grating machine and screw press. It was, however, noted that other key areas that require interventions are peeling and roasting. All the processors interviewed use manual means for cassava peeling and it was identified as the operation that requires the highest number of persons (15-18 people), to peel about 5-6 tonnes of cassava using about 6-9 hours. The process of manual peeling was identified as the main source of postharvest loss during small-scale processing of *gari*, resulting in about 13.90 (± 1.26) % loss of fresh cassava which can produce about 178 kg of *gari* (from 5-6 tonnes of cassava). An effective mechanical peeler is therefore identified as key to facilitate *gari* processing in terms of operation speed and eliminating the over-dependence on manual labour. Other important developed interventions like mechanical roasters and improved stoves are also recommended to enhance *gari* processing. Outcome from this study is useful to researchers, investors, processors, policy makers and other stakeholders on the specific aspects of the *gari* processing to focus on in terms of research and investment.

Key words: Cassava processing, *gari*, peeling, drudgery, postharvest losses, mechanisation, manual labour



INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a highly perishable root crop with numerous applications [1]. It has high moisture content (about 60-70% wb) and begins to deteriorate about two to three days after harvest under ambient temperature [2, 3]. This makes processing of cassava very important in preserving it, as it enables the production of shelf-stable and more valuable derivatives of the crop for storage [1]. Processing of cassava may involve a number of operations such as peeling, grating, drying, dewatering, roasting, and milling, among others.

In Ghana, processing of cassava into products like *agbelima* (dough), *gari* (roasted fermented grits), tapioca and *kokonte* (dried pellets) is mostly done using traditional methods of processing mainly at the village and small-scale levels [4]. Quaye *et al.* [5] stated that village level processing accounted for preservation of bulk of the agricultural products in Ghana and contribute immensely to the postharvest food system. This is as a result of the large number of people involved at this level of processing around the country due to the simple and cheaper processes and equipment involved. However, processing using traditional methods has been reported to be tedious, slow, low yielding and result in low quality products [5–7]. As a result, they limit the potential benefits one can derive when adopted and can lead to some level of postharvest losses due to the slow nature of operation.

Agricultural mechanisation and the use of innovative technologies have been noted to have tremendous benefits such as increase in income, productivity and standard of living as well as reduction in the level of drudgery and time spent on agricultural activities [8, 9]. Kolawole *et al.* [10] recommend that it is critical to develop indigenous processing equipment and technologies to ensure efficient mechanisation of cassava processing. Such equipment when adopted by processors can boost cassava production and improve the quality and quantity of the processed products [11]. It will also ensure a reduction in the level of postharvest losses encountered during traditional level processing and improve food security [10]. This has become even more necessary since the demand for processed cassava products continue to increase on the local and international markets both for domestic and industrial uses [7].

In Ghana, *gari* is among the major processed products from cassava. *Gari*, a roasted fermented cassava meal, is recognised as the most popular processed cassava product in Ghana and the main export cassava product from Ghana to Europe, USA and some sub-regional markets in West Africa [4, 5]. Locally, there is demand for it from households, boarding schools, hospitals as well as other government institutions [4]. *Gari* is produced mostly by village and small-scale level processors using traditional methods. The main processes involved in its production are peeling, washing, grating, pressing and fermentation, sieving and roasting. Quaye *et al.* [5] reported that all these processes have been mechanised apart from peeling. Ehinmowo and Fatuase [12] also concluded that mechanical grating was the most used technology while mechanised peeling was the least adopted technology among processors in South-West Nigeria. Knowledge on the availability and state of adoption of these technologies by processors is necessary in addressing the challenges encountered during processing of cassava into *gari*. This

study therefore sought to assess how challenges encountered by small-scale processors of *gari* can be addressed through adoption of improved technologies.

MATERIALS AND METHODS

Study area

The study was undertaken in some selected cassava processing communities located in the Ashanti and Bono East Regions of Ghana. Some processors of *gari* in Kumasi, Mampong, Woraso and Sekuruwa in the Ashanti Region as well as others from Techiman, Bamire and Asueyi in the Bono East Region were involved in the study. These areas are among the major cassava producing and processing areas in the country with majority of farmers engaged in smallholder cassava production.

Data collection

Focus group discussions and semi-structured questionnaires were used in collecting data for the study. Four focus group discussions were organised at Anloga in Kumasi, Bamire, Asueyi and Woraso (Ghana). Each focus group involved about 8-12 *gari* processors from these areas and surrounding communities. Among some of the issues addressed by the focus groups were technologies employed for various *gari* processing activities, major challenges encountered by small-scale *gari* processors, main causes or sources of postharvest loss during *gari* processing and areas that require technological intervention. Processors were selected using purposive and snowballing sampling techniques. The processors who participated in the study were representatives of larger groups of cooperatives and associations of processors in the study areas.

In addition to the qualitative data, an experimental study was undertaken to determine the level of loss encountered during manual peeling, especially using the shearing method¹ commonly used by small-scale cassava processors. The experiment was undertaken at the *gari* processing site at Anloga in Kumasi and women engaged in peeling of cassava were employed. Three samples of 10 kg each were peeled using the shearing method of peeling. Time taken to peel the cassava was recorded with the aid of a stopwatch. Also, the proportion of cassava peel and flesh (peel to flesh ratio) was determined by carefully peeling three samples of cassava using the unwrapping method and weighing both flesh and peels as reported by Oluwole and Adio [13]. Percentage flesh loss was determined using Equations 1 according to Adekunle *et al.* [14].

$$\text{Percentage flesh loss (\%)} = \frac{M_{\text{fl}}}{M_{\text{ft}}} \times 100 \quad (1)$$

where M_{fl} is mass of cassava flesh lost through peeling and M_{ft} is total mass of cassava flesh

¹ Shearing method of peeling cassava is the process where the cassava peel is separated from the flesh with the aid of a knife in a motion similar to sharpening a pencil with a cutter. It is the method commonly used by most small-scale processors because it is faster than the more efficient unwrapping method which involves slitting the peel on one side of the root and rolling back the peel from the flesh using the knife and fingers

Data analysis

Data collected from the focus groups was processed descriptively. Quantitative data from the peeling experiment was also analysed using descriptive statistics.

RESULTS AND DISCUSSION

Business characteristics and operations

The years of experience of the people engaged in the study ranged between 5 to 30 years with an average of over 15 years of experience. Some of the *gari* processors indicated that they were introduced into the business by their parents while they were young and have since been engaged in it. On average, about 5-15 tonnes of *gari* is processed monthly by the processors in the study areas. All processors indicated they source their cassava from local farmers around their communities, except those in Kumasi who reportedly purchase their cassava raw material from areas like Mampong, Techiman, Akomadan and Dormaa in the Ashanti and Bono East Regions of Ghana. Concerning the variety of cassava processed, *gari* processors did not have any preference but most of them relied on the available varieties in the farming community.

From the study, all the processors noted that during *gari* processing, peeling and roasting are the most critical operations. These same operations are considered the most time-consuming and labour-intensive.

Adopted technologies in gari processing

From the results of the study, it was analysed that cassava grating and dewatering of cassava dough are the operations that were identified to have been mechanised by all the processors that participated in the study. Some of the cassava grating machines were powered by diesel engines while others were powered by electric motors. It was established that, due to cost of owning such mechanised operating machines, about 80 % of the women groups engaged in *gari* processing depend on cassava grating service providers who operate on charge-per-run basis while the remaining owned and operated their own grating machine. The cost of grating a KIA truckload (about 6 tonnes) of cassava was reported on average as GH¢ 85 (\$ 14). The duration for grating was given as between 1 to 4 hours, depending on the capacity of the grater. With respect to dewatering or pressing, all the *gari* processors interviewed depend on the use of a screw press which is operated manually. This means that women processors have to rely on the services of the youth in the area who are engaged at fees between GH¢1-1.5 (\$ 0.17-0.25) per bag to operate the screw press since it requires some level of energy input. To address this labour-intensive activity and labour scarcity during certain periods, the use of a hydraulic press which is easier and faster to operate is recommended although it requires higher capital investment and a source of electricity.

The findings of the study revealed that, processing activities like peeling, washing, sifting, and packaging are done manually by all the processors in the study areas. In addition, roasting of the *gari* was reported to be mostly done manually using the traditional open stove by the women groups who were engaged in the study. Only about 5 % of the women groups had installed an improved stove which has a chimney to

remove smoke during roasting from the processing area. Also, only one women group in the study area, Woraso was identified to have installed a mechanical roaster which can be used to roast about thrice the capacity of three manual roasters at the same time. This gives an indication of an increase in productivity resulting from adoption of improved technology [9]. On the contrary, Oriola and Raji [15] reported that the use of manual labour during processing can be labour intensive and reduce productivity leading to higher cost. This is highlighted from the study as it was observed that to process a KIA truckload of cassava into about 9-11 bags of 100 kg *gari* in the study areas, about 41-57 people are needed at a cost of GHC545-730 (\$ 90-121). Table 1 highlights the detailed breakdown of cost for manual labour involved in *gari* processing.

Challenges encountered in gari processing

The study revealed that, one major challenge during *gari* production is peeling of the cassava roots. The manual method of peeling (Plate 1) employed requires that processors engage the services of about 15-18 women (and sometimes adolescent girls) per KIA truckload (5-6 tonnes) of cassava to be processed. The process is tedious as the women groups spend about 6-9 hours in peeling this quantity of cassava.



Plate 1: Peeling of cassava by manual means at Bamire

The shearing method of manual peeling used also results in some loss of cassava flesh which processors complained about. Unlike the unwrapping method of peeling which is efficient at recovering almost all the cassava flesh, the shearing method adopted by cassava processors due to its speed results in some loss of cassava flesh. The situation whereby women engaged in peeling are paid based on the quantity of cassava peeled, as was indicated by some focus groups, encourages fast peeling leading to even higher

losses. Again, the level of loss increases as the duration of peeling is prolonged due to fatigue. Processors indicated that, without strict supervision, those engaged in peeling tend to peel without caution, leading to more flesh being lost. The quantity of cassava root lost due to manual peeling was reported to be about 150 kg (which translate into ~30-40 kg of *gari*) per 5-6 tonnes by some processors. However, result from the experimental assessment indicates that about 13.90 (± 1.26) % of cassava flesh is lost through peeling (Table 2) and this can translate into about 178 kg of *gari* for every 5-6 tonnes of fresh cassava processed. This is corroborated by Ilori and Adetan [16] and Tobiloba *et al.* [17], who stated that peeling by shearing method is less satisfactory because it leads to some cassava flesh being lost while some peel may also remain on the flesh.

Unavailability of labour for peeling was also identified as one key challenge hindering the operations of the women groups in *gari* processing. The lack of labour was attributed to other competing profitable economic activities in the study areas. For instance, at *Awurade Ne Boafo* processing group at Bamire, it was reported that other activities like picking of mangoes, cashew nuts and other seasonal cash crops (particularly when they are in season) keep the women labourers away, thereby resulting in the processors' inability to have access to them for peeling during such periods. At Josma Agro Industries in Woraso, it was also reported that the women labour force sometimes travels to other farming communities to take up other farming jobs.

Additional challenge reported from the study by *gari* processors was the manual method used for roasting. The garification process was identified as the most critical operation due to its effects on the final product quality and therefore requires dedicated attention and effort. All the processors engaged reported using manual operation for roasting *gari* and require about 10-14 women to process a truckload of cassava over a period of 8-9 hours. This makes the process very tedious and often results in poor quality *gari*. The challenge is further worsened by the poor working conditions these women groups are exposed to as a result of the traditional stove used for the roasting operation (Plate 2a). Such traditional stoves use firewood which generates a smoky environment while burning and creates discomfort to the workers. Absence of smoke at the roasting area was however observed at Woraso and Asueyi, two of the *gari* processing communities visited where an improved stove (Plate 2b) system which is designed with a chimney to channel the smoke out of the processing area has been adopted.



A



B

Plate 2: Manual roasting of *gari* using traditional (a) and improved (b) stoves

It was also noted that, the processors face the challenge of accessing fresh cassava for *gari* processing during the lean season. Availability of cassava on the market in Ghana has been identified as cyclic in nature. From time to time, there is a glut of cassava leading to a drastic reduction in the price of cassava, while at other times, there is a limited supply of cassava resulting in a drastic increase in the price. Processors around Techiman indicated that the price for a KIA truck of cassava was between GHC 4,000-5,000 (\$ 662-828) and GHC 1,000-2,000 (\$ 166-331) in the lean and bumper seasons, respectively. This fluctuation in supply has been attributed to farmers planting less cassava usually during a bumper season which culminate into lower production the following year (lean season). Darko-Koomson *et al.* [4] reports that processors sometimes have to import cassava from Togo and Cote D'Ivoire during the lean season in order to be in business. The insufficient supply encountered from time to time affects both operations and income of processors.

Again, one more challenge with the *gari* processors was the lack of ready market for *gari* especially during the bumper season of cassava production. At the time of the study, it was reported by some *gari* processors that they have large quantities of *gari* in store but had no market for it. This problem can be attributed to the large number of people engaged in *gari* processing in the areas the study was conducted.

One other major challenge as reported by the women groups was lack of access to capital to invest in their *gari* processing business. Due to the quality requirement in *gari* processing, a number of improved processing units are needed to ensure timely processing. Such equipment are however capital intensive hence, individual processors face the challenge of raising enough capital to acquire them to support their processing activities.

Apart from these reported challenges, other issues like high cost of transportation, high cost of fuel and energy (mostly firewood and electricity) for processing, drudgery involved in operating the screw press and poor conditions in the working environment (especially with those who use the traditional stoves) were identified as affecting the operations of the processors. These challenges limit the operations of cassava

processors, increase the level of postharvest losses in cassava processing and as well hinder their growth and expansion. Effectively dealing with the identified challenges will boost the operations of the women groups and ultimately reduce postharvest losses during cassava processing.

The way forward

To improve small-scale *gari* processing in Ghana, there is the need to develop technologies as well as disseminate existing technologies to enhance adoption. With manual peeling identified as a major challenge by all the processors in the study areas, consideration should be given to the development, evaluation and dissemination of efficient mechanised peeling machines to augment the operations of the small-scale cassava processors. Such a peeler should be developed based on the physical and mechanical properties of major cassava varieties used by processors in order to ensure efficient performance [18]. Processors from all the women groups expressed interest in adopting a mechanical peeler since it has the potential to improve their operations by reducing the peeling time and prevent losses from deterioration due to delayed processing. In conveying her interest, a processor among the Anloga *gari* processors in Kumasi stated that a mechanical peeler will make processing of *gari* easier and faster. Also, another processor of the *Awurade Ne Boafo* group at Bamire indicated the use of a mechanical peeler will remove the labour bottleneck, provide assurance about continuous processing and facilitate faster processing operations. The women groups involved in *gari* processing expressed their willingness to patronise the service of mechanical cassava peeling on service for a fee basis. Adekanye *et al.* [19] indicated that the cost of a mechanical peeler is beyond small-scale cassava processors, justifying their request for the service charge basis.

With respect to a mechanical roaster and improved stove for *gari* processing, the existing examples (as witnessed at Woraso) should be promoted for adoption and dissemination among *gari* processors. Individual processors who have the ability to acquire such equipment and facilities can purchase them while others without the financial strength can work within their cooperatives and groups to acquire them. Investors interested in the sector can also support training of artisans in the local communities to undertake construction of these facilities in order to reduce the cost involved in acquiring them.

On marketing, the women groups involved in *gari* processing need training to improve their skills to enable them process high quality *gari* that could meet export market demands. This will ensure the groups can process *gari* at the small-scale level using improved technologies that lead to increase in income and improvement in the livelihood of the women groups. Quaye *et al.* [5] report availability of market as one of the requirements for the production of high grade *gari* (HGG) and high quality cassava flour (HQCF) by processors. The quality and equipment requirement for processing HGG and HQCF is quite high in terms of capital investment. This might be the reason why many processors at the small-scale level prefer going into low grade *gari* processing which does not meet export market. Therefore, support in terms training and processing equipment can be given to some of these *gari* processors to enable them

engage in HGG and HQCF processing. Quaye *et al.* [5] indicate that training on quality issues is a necessary requirement for adoption of HQCF processing.

The high cost of fuel (firewood) and energy (electricity) for processing of *gari* was also identified as a major challenge to the small-scale women groups. To reduce the amount of money spent on energy, cheaper alternatives such as agro-residues (for example palm kernel shells, coconut husk and maize cobs, among others) could replace the current dependence on firewood. Such an initiative was identified with the women group at Woraso where the processors have replaced firewood with palm kernel shells as cheaper source of fuel for processing of *gari*. Palm kernel shells, though a by-product from the processing of oil palm, have been reported as valuable source of renewable energy, especially for developing economies like Ghana [20]. Adopting its use also has the potential of reducing the level of deforestation and its associated challenges resulting from cutting down trees as firewood. Another useful alternative source of energy is the generation and utilisation of biogas from the waste produced during cassava processing. With about 60% methane content, biogas from cassava peels can be used as source of fuel by processors [21]. This can replace firewood or be used to generate electricity to supplement or replace power from the national grid for processing. It will also help in dealing with the environmental pollution created at some processing sites by effluent from cassava processing [4].

Access to finance is a major limitation of small-scale *gari* processors and needs to be addressed to ensure expansion and sustenance of the production of HGG and HQCF. Darko-Koomson *et al.* [4] suggest that considering the important role cassava plays in the economy of Ghana, priority should be given to actors in the sector in the implementation of government microcredit programmes. This will ensure that processors of cassava have access to some form of financial support for their operations. They also suggest that, in situations where farmers and processors find difficulty in accessing credit facilities, they can adopt the Village Savings and Loans Association (VLSA) model to generate funds in support of each other. This proposal can be feasible with *gari* processors due to the number of women groups involved in *gari* processing.

CONCLUSION

The study evaluated the challenges encountered by processors of *gari* in parts of Ghana and the ways in which these challenges can be resolved mostly through the adoption of improved technologies. The improved technologies identified for *gari* processing by the women groups interviewed were the mechanical cassava grater and screw press. The major challenges identified were manual peeling of cassava, manual roasting of *gari*, seasonal unavailability of cassava for processing, lack of ready market for *gari* and inadequate financial investment. Other problems identified include high cost of energy, poor working environment conditions due to exposure to smoke and high cost of transportation. Development, evaluation, and adoption of efficient mechanical peeling equipment, promotion for adoption of already existing technologies such as mechanical roaster for *gari*, training and support for processors to produce HGG and HQCF are some of the proposed solutions. Resorting to cheaper alternative energy



sources and technologies are also recommended to improve the operations of small-scale *gari* processors.

These findings imply that researchers, investors, policy makers and other stakeholders in the cassava value chain need to focus effort and resources into dealing with these challenges in order to improve the sector. This will enable cassava farmers, processors and the country at large to generate maximum benefits from the sector.

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Table 1: Cost of operations in *gari* production

Operation	Number of persons	Cost (GHC)
Peeling	15-18	110-150
Washing	3-6	15-60
Grating*		80-90
Dewatering*		40-60
Sifting of dough	10-14	50-70
Roasting	10-14	200-240
Sifting of <i>gari</i>	3-5	50-60
Total	41-57	545-730

*Done using mechanical equipment

Table 2: Results for percentage flesh loss determination

Sample	Mass of peeled flesh (kg)	Mass of peels (kg)	Total mass (kg)	*Total mass of cassava flesh (kg)	Mass of flesh lost (kg)	% Flesh loss
1	6.6	2.5	9.1	7.69	1.09	14.17
2	6.6	2.6	9.2	7.77	1.17	15.06
3	6.8	2.4	9.2	7.77	0.97	12.48
Mean	6.67 (±0.12)	2.5 (±0.10)	9.17 (±0.06)	7.75 (±0.05)	1.08 (±0.10)	13.9 (±1.26)

*Based on determined flesh ratio of 0.845 according to Ademosun *et al.* [22]

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