Available online at www.koozakar.com/journal/ajspim

African Journal of Science Policy and Innovation Management
OPEN ACCESS | PEER REVIEWED
AJSPIM

A Characterization of Processing Technologies in the Small-scale Yam Flour Processing Industry in Southwestern Nigeria

Tomilola Oguntunde[1]*, and Olawale Adejuwon[2]
[1]Osun State Polytechnic, Iree, Nigeria
[2]Obafemi Awolowo University, Ile-Ife, Nigeria

*Corresponding author
Email: oguntundetomilola4@gmail.com

Article information

https://doi.org/10.69798/72212215

3066 – 3997

Published by Koozakar LLC. Norcross GA 30071, United States

A Journal of the African Institute for Science Policy and Innovation, AISPI, Obafemi Awolowo University, Ile-Ife. Reproduced with permission.

ABSTRACT

This study examined the types of technologies available for yam flour production in southwestern Nigeria with a view to examining the perceived efficiency of technologies used in the sector. The study was limited to Osun, Ogun and Oyo States in Southwestern Nigeria where there is high prevalence of yam flour processing activities. Data for the study were obtained from questionnaire administration on 30 fabricators of yam flour processing technologies and 210 small-scale yam flour processors selected by a multi-stage sampling technique. The findings indicated that technologies were available for all unit operations of yam flour processing. However, with the exception of technologies for the milling stage, other technologies for other stages were either inappropriate or inefficient for the small-scale processors.

Keywords: Yam flour, Processing, Milling, Technique

INTRODUCTION

Achieving food security and meeting nutritional needs as established by the millennium development and sustainable development goals may yet be another elusive quest in sub-Saharan Africa without the mechanization of the region's small-scale agricultural sector. Small-scale agricultural activities play an important role in economic growth by enhancing food security, reducing poverty and boosting rural development (Mwangi and Kariuki, 2015). The sector is the main source of income for about 2.5billion people in the developing world (Food and Agricultural Organization, 2013). Small-scale agricultural activities are a source of employment for more than half of the total labour force in sub-Saharan Africa (IMF, 2012) However, while small-scale agriculture has supposedly played an important role in reducing poverty and transforming the economies of many Asian and Latin America countries, the same cannot be said for Africa as there are lingering issues of food security and poverty within the region.

Yam (Dioscoreaspp), is an annual or perennial root tuber bearing plant that belongs to the family of dioscoreaceae (Salawu, *et al.*, 2014). There are over 600 species of yam. Some originated from Africa and spread to other parts of the world. Today, yams are grown widely throughout the tropics and have a large biological diversity. However, only six out of the 600 species are widely cultivated in West and Central Africa (Nweke *et al.*, 2013). These six species are regarded to be socially and economically important in terms of food, drugs and medicine (IITA, 2009). Africa is the lead player in the production of yam and cassava, producing about 95% of the world yam production (FAOSTAT, 2013). In 1961, Nigeria produced 42% of world yam production (3.5 million metric tons) and by 2012 the country accounted for over 65% of the world yam production (38 million metric tons) valued at $7.75 billion and cultivated on about 2.9 million hectares of land (FAO, 2013). Yam cultivation is very profitable in spite of the high cost of production and fluctuations in market price (IITA, 2013; Izekor and Olumese, 2010). The average profit per yam seed after harvest and storage in Nigeria was calculated at over US$13, 000 per hectare harvested (IITA, 2013). However, according to Asumugha *et al.*, 2007, there is a need for increased production of yam to meet growing national and potential export demand. The export of yam in all forms is still low till date.

Yam is consumed by processing the fresh roots. Products obtained from yam processing include boiled yam, dried yam chips (gbodo)/yam flour (elubo), pounded yam, poultry and livestock feed, and in recent times industrially produced poundo yam. Yams are also consumed in form of fried chips, roasted and fried yam balls and yam porridge. (Osagie, 1992).According to Ige and Akintunde (1981), the processing of yam traditionally depends on the species processed. Dioscorea rotunda or Dioscorea esculenta are usually preferred for yam flour processing. Processing yam immediately after harvesting serves as an effective procedure against storage loss. The tubers are washed, peeled, sliced, parboiled and dried. The dried slices are grounded into flour and sieved to produce a uniform texture. The resulting product is white, cream or grey coloured flour, which can be stored for months. This flour is called yam flour or elubo in Yoruba language. According to some studies, (Odior and Odewale 2012; Omohimi *et al.*, 2017), there are five stages of processing yam into flour; peeling, slicing, parboiling, drying and milling. Yam tubers are carefully peeled to a desired thickness. The yam slices are then blanched in boiling water for some minutes depending on the thickness of the slices and after which the blanched yam slices are dried. The dried yam chips (gbodo) are then pulverized directly into flour of uniform texture using a mortar and pestle.

Technology whether old or new is a critical factor in any production system today (Ilori *et al.*, 2002). Productivity in terms of quality and quantity of output can be enhanced with the use of appropriate and efficient technology (Adejuwon, 2014; Oladele and Adejuwon, 2024). Appropriate and efficient technology is even more important in the agricultural sector where such technologies can be used to enhance farm yield, reduce post-harvest loses and add value to agricultural activities. Therefore, when there is a perceived form of inefficiency and inappropriateness of a production technology, it becomes imperative to investigate these challenges and develop solutions. Many of the challenges of production technologies have not been adequately documented in the agricultural sector, essentially in the small-scale yam flour processing sector.

This study aims at examining and proffering information to policy makers, fabricators and scholars on the specific nature, features, strengths and weaknesses of yam flour production technologies in Southwestern Nigeria

METHODOLOGY

Study Area and Data Collection

The study was conducted in the South-western part of Nigeria. This region is the ancestral home of the Yorubas who are the major processors and consumers of yam flour. About 25 million Yorubas can be found living in the region. The study was limited to Oyo, Ogun and Osun States of Southwestern Nigeria where there is a high prevalence of yam flour (elubo) processing clusters.

Primary data was collected using two sets of questionnaire and interviews. The first set of questionnaire was administered on 30 fabricators of food processing technologies and elicited information on the technologies available for yam flour processing in the sector. The second set of questionnaire was administered on 210 yam flour processors and elicited information on their awareness and knowledge on the use of technologies for processing yam into flour. The respondents were selected by a two-stage sampling technique. For the processors, the first stage involved the purposive selection of municipalities known for yam flour processing while the second stage involved the random selection of processors from yam processing centers in the selected areas. For the fabricators, the first stage involved a purposive selection of research institutes, private firms, tertiary institutions with Agricultural Engineering departments and registered associations of artisanal metal fabricators. The second stage involved the random section of respondents from the identified groups

RESULTS AND DISCUSSION

Questionnaire retrieval rate was 73% for fabricators and 85.2% for processors. Only one research institute, the Federal Institute for Industrial Research, Oshodi (FIIRO), Lagos State, Nigeria was found to fabricate technologies for yam flour processing. Twenty-five private fabricating firms were also found in the business of fabricating technologies for the sector. Five of these were registered sole proprietorships while the remainder was informal outfits.

The Types of Processing Technologies for Yam Flour (Elubo) Processing

Table 1 shows the types of technological innovations that were available for yam flour processing in the study area. FIIRO was the only organization that was found to fabricate technologies for the slicing unit operations in the study.

The machine (Figure 1) has a capacity to slice 250kg/hr. of yam and is sold for ₦325, 000.FIIRO and a local company fabricates different types of parboiling machines. The par boiler (Figure 2) fabricated in FIIRO is sold for ₦650,000 and it has a capacity to hold 1000 Litres of water. The par boiler at FIIRO is made of perforated metal slates (Figure 3) on which the yam chips are arranged while the par boiler fabricated at a local company has the capacity to process 250kg of yam per batch. Enquiries revealed that the price was ₦450,000. For the drying operations, the local company fabricates a yam dryer that can effectively dry 250kg of yam in 50 minutes while the cabinet dryer (Figure 4) fabricated at FIIRO has the capacity to process two (2) tonnes of yam in 24 hours. The price of the yam dryer is ₦1,800,000 while the cabinet dryer is valued at ₦650,000. Interviews revealed that both technologies were developed to create a more hygienic environment for drying of sliced yam. For the milling operations, all of the fabricators fabricate one type of hammer mill. The hammer mills are powered by diesel, petrol or electricity. Another local company and FIIRO fabricate two different types of hammer mills; the primary hammer mill (Figure 5) that can crush dried yam (gbodo) into smaller pieces and the secondary hammer mill that further grinds the crushed dried yam into finer yam flour. Artisans fabricate the hammer mill that grinds crushed dried yam into finer flour. Interviews revealed that most of the artisans fabricate based on demand from customers and this was further confirmed by vendors of different type of hammer mills as they claimed to have imported from some of the mills, they offer sale from overseas.

Table 1: Types of Processing Technologies for Yam Flour Processing

Innovation		Prototype	Price
Mechanical peeler	Capacity	-	-
	Fabricator	-	-
Yam slicer	Capacity	200kg/hr.	₦325,000
	Fabricator	Federal institute of Industrial Research	
Par boiler	Capacity	a. 1000litres[a] b. 250kg per batch[b]	a. ₦650,000 b. ₦450,000
	Fabricator	a. Federal institute of Industrial Research b. Local company	₦1,800,000
Yam dryer	Capacity	250kg per batch of 50 minutes	
	Fabricator	Local company	
Cabinet dryer	Capacity	2 tonnes/day	₦650,000
	Fabricator		
Hammer mill	Capacity	200kg per batch	₦450,000
	Fabricator	Artisan	
Primary Hammer Mill	Capacity	a. 1 ton/hr[a]. b. 250kg/hr[b].	₦680,000
	Fabricator	a. Federal Institute of Industrial Research b. Local company	
Multi-purpose Hammer Mill	Capacity	250kg/hr.	₦750,000
	Fabricator	Local Company	

Figure 1: Yam Slicer

Figure 2: Yam Par boiler

Figure 3: Perforated metal

Figure 4: Cabinet dryer

Figure 5: Primary Hammer Mill

Depiction of the Technologies among small-scale processors

Only 4 (2.2 %) of the processors were aware of the mechanical peeler, 86 (48.1%) were aware of a yam slicer while 10 (5.6%) knew of parboilers and only 6 (3.4%) knew of the cabinet dryer. All of processors knew of the primary and secondary hammer mills. The mechanical peeler was however not adopted. This outcome suggests that there is a huge gap in the awareness of processing technologies among the processors. Adejuwon (2014) reported that the level of awareness hindered the adoption of threshing technologies in oil palm fruit processing. Oguntunde (2023) also reported that lack of awareness influenced the adoption of rice processing and production technologies

The processors reported that the machine peeled off the skin of yam completely. It was noted during the study that the yam skin was not peeled off completely by the processors using knives. This left a form of design on the yam. This method of peeling and leaving some yam skin as a design was found to have been passed down from generations. Others found the slicing machine too tiresome to use.

The inefficiency of the cabinet dryer to effectively dry the yam chips hindered its adoption of among processors interviewed in Saki, Oyo. Also, available parboiler in the region were custom made and rather expensive for the small-scale processors. Enquiries from the field indicates that technologies for the slicing, boiling, drying and milling stages cost ₦2.985,000.

However, interviews with the processors revealed that the hammer mill was presumed to be the most appropriate technology for the milling stage. All the processor used it for milling. However, very few processors owned this machine but they paid to use it for milling when necessary.

CONCLUSION

Findings in this study revealed that although there were processing technologies for yam flour processing, the technologies being used among small scale processors in the study are characterized as inappropriate and inefficient in some cases.This continuous use of rudimentary tools within this sector can also be perceived as a result of the aforementioned challenges.

Based on the findings of this study, it is therefore recommended that

i. Government should help strengthen research capabilities among institutions saddled with the responsibility of providing technologies for small-scale yam flour processing so as to furnish the processors with modern labour-saving processing techniques that could enhance productivity and profitability.
ii. ii. Government institutional policies should be modified to improve on the provision of training programmes to disseminate scientific knowledge and the importance of new technologies to artisanal fabricators.

REFERENCES

Adejuwon, O., Taiwo, K. and Ilori, M. (2014). Promoting technology adoption in the small scale oil palm fruit processing sector in south-western Nigeria: an innovation systems approach. African Journal of Science, Technology, Innovation and Development. 6(2), 75–92

Africa Union, (2006).Summit of food security in Africa.www.Africa-union.org

Asumugha, G.N., Lemka, D., Ogbonna, M., Okoye, B.C., Dung, E., Njoku, M.E. and Nwosu, K.I. (2007): An Analysis of the Marketing Channels and Efficiency of the Marketing Livelihoods through Yams. Workshop, Accra, 11–13 September 2007

Food and Agriculture Organization (2013)

FAOSTAT (2013). FAOSTAT database Available at http://faostat.fao.org. Accessed 21 June 2015

Ige M.T and F.O Akintunde (1981). Studies on the local technique of yam flour production. Journal of food technology 16, 303- 311

IIITA (2009): Yam (Dioscorea species).Available at: http://www.iita.org/yam. [Accessed June, 2016.

IITA (2013): Healthy yam seed production. IITA Publications. Retrieved http:// www.iita.org/publications

Ilori, M.O., Adeniyi, A.A., Oyewale, A.A., Sanni, S.A., and Irefin, I.A. (2002): "Development a manufacturing-based economy in Nigeria through science and technology," Technovation, vol. 22, no. 2002, pp. 51 – 60.

International Monetary Fund (2012). International Jobs Report, Economist Intelligence unit, Washington, D.C.

Izekor, O. B. and Olumese, M. I. (2010).Determinants of yam production and profitability in Edo State, Nigeria. African Journal of General Agriculture 6(4), 205–21.

Mwangi, M and Kariuki S. (2015) Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries Journal of Economics and Sustainable Development, 6 (5) 222-285

Nweke F., Aidoo R., Okoye B. (2013) A Technical Report on Yam Consumption Patterns in West Africa.

Odior A.O. and Orsarh E.S. (2012) Design and Construction of a Yam Pounding Machine. International Journal of Natural and Applied Sciences. 4(3), 319-323

Oguntunde, T. F (2023) A Study of Gender Responsiveness in Technologies for Small-scale Rice Production and Processing in Southwestern Nigeria. An Unpublished Doctoral thesis submitted to the Postgraduate College, Obafemi Awolowo University, Ile-Ife, Nigeria

Oladele, W. O. and Adejuwon, O. O. (2024) Adoption of Production Tools in Agro-allied Artisanal Metal Fabrication in Southwestern Nigeria: Implications for Access to an Essential Tools Infrastructure. Ife Journal of Technology, 29 (1), 37- 43

Omohimi, C.; Piccirillo, C.;Roriz, M.; Ferraro, V.; Vasconcelos, W.M.; Sanni, L.O.; Pintado, M.M.; Abayomi, L.A. Study of the proximate and mineral composition of different Nigerian yam chips, flakes and flours. Journal of Food Science Technology 55, 42-51

Osagie, A.U. (1992). The Yam Tuber in Storage. Post-Harvest Research Unit, University of Benin, Nigeria. 107-173.