Journal of Agricultural Technology 2011 Vol. 7(5): 1193-1198
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Development of a cassava processing plant for producing improved stone-free gari

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Adegun, I. K., Ajimotokan, H.A. Akinlosoye, A. A. and Babarinde M.S. (2011) Development of a cassava processing plant for producing improved stone-free Gari. Journal of Agricultural Technology 7(5): 1193-1198.

Cassava processing is low income in the countries in Africa, has usually done manually and other manual operations. The design and fabrication of a cassava processing units for producing to improve Gari was developed as it is stone-free from cassava root for any market oriented production. The procedure included the design, construction and testing to estimate the products of cassava processing. The plant was made up the washing, grating, dewatering, sieving and frying units. Samples of 20 kg, 25 kg and 30 kg of peeled cassava roots were fed into the washing unit and afterwards grating, dewatering, sieving and frying that resulted to obtain 11.5 kg, 14.4 kg and 17.3 kg of stone-free Gari as final products, respectively. The grater and sieve efficiencies were estimated as 95 % and 93 %, respectively.

Keywords: Cassava, cassava processing, stone-free gari, development, market oriented production

Introduction

Cassava scientifically called *Manihot esculenta* (Asiedu, 1990; Akinlosoye and Babarinde, 2009) and a botanically member of the *Manihot utilissima.* It is a starchy, root crop, grown throughout the tropical world. Cassava is second only to the sweet potato as the most important starchy root crop (Grace, 1997) and it is known around the globe for its trade values as starchy crop, food and feed crop. It has an encouraging future as international substrate for the production of protein by yeast and fungal fermentation (Olayinka, 1997; Akinlosoye and Babarinde, 2009). Cassava is an important tropical plant serving the following importance, source of industrial starch granules, important in chemical processing of ethanol and other substances, source of flour, peeled roots can be crushed and fermented before frying to produce "semi-dextrin food stuff" called Gari among others (Akinlosoye and Babarinde, 2009). Gari is the most popular staple food derived from cassava

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and it is a creamy-white, granular flour with a slightly fermented flavour and a slightly sour taste made from fermented, gelatinized fresh cassava roots (International Institute of Tropical Agriculture (IITA, 2005).

Cassava roots are perishable and contain potentially toxic cyanogenic glucosides (Sanni, *et al.*, 1994). Therefore, they are processed exclusively for human consumption in Nigeria and other West African countries. The principle of preservation and processing cassava is made by fermentation to remove cyanide and produce the desirable flavours. It is then roasted to destroy enzymes and microorganisms, to drive off cyanide gas, and to dry the product. Preservation is achieved by heating during roasting (IITA, 2005; Montagnac, *et al.*, 2009). Cassava processing is constrained by a lack of steady supply of tubers throughout the year, high transport cost to processing centres, inadequate processing equipment and low returns from small-scale processing (Davies, *et al.* 2008). Literature is repeated with reports that cassava processing operations for Gari production is labour intensive, time consuming and drudgery; and is widely performed by women and children (Osunbitan, *et al.*, 2000; Davies, *et al.* 2008). Poor quality of manually produced Gari has been traced to problem associated with peeling, grating, milling, dewatering, sieving and roasting, which are all labour intensive.

This study was aimed at alleviating some of these problems that encountered by traditional processors by mechanization of cassava processing operation to enhance human capacity, leading to intensification and to increase in production of an improved Gari.

Design Consideration

The design and development of these units, engineering were practiced that involves in utilizing scientific principles to develop component and system to perform effectively, reliably and satisfactorily. However, the materials for the fabrication of the equipment were studied by considering strength, suitability and local availability.

Materials and methods

A cassava processing plant comprising the washing, grating, dewatering, sieving and frying units for producing an improved Gari that is stone-free that was designed and developed. The procedure included the design, construction and testing or estimation of the products of cassava processing. The materials were galvanized steel, galvanized iron, angle bars, stainless steel and galvanized mesh wires.

Equipment description

The plant is made up the washing, grating, dewatering, sieving and frying units as depicted in Figures 1, 2, 3, 4 and 5. The washing unit comprising the cylindrical housing, cage drum, shaft and the handle; a galvanized steel sheet metal of 1mm thickness in cylindrical semi-circular shape of size 1350mm length by 800mm diameter sealed at both ends was designed for cleaning the cassava roots. The grating unit comprises the hopper, shaft with perforated metallic grating element, discharge chamber (chute), prime-mover and the pulley. The dewatering unit comprises the frame, solid woods and a 3ton hydraulic jack. The sieving unit comprises the sieving chamber, sieving net, frame support, a spring vibrator and chaff discharge chamber. The frying unit comprises the cylindrical frying pot, heating elements, thermostat, turning shaft with blades, bevel gears and handle.

Evaluation procedure

A test was conducted using the units in series with 20 kg, 25 kg and 30 kg of the peeled cassava roots. These samples were fed into the washing unit for proper cleaning of the root. Thus, grating was performed and pulp of the grated cassava were packed into a sack, and taken to the dewatering unit for dewatering. Afterwards, the dewatered pulp was sieved employing the sieving unit to separate the chaff from the pulp. These were then fried in the frying unit to obtain Gari as the final product.

Fig. 1. Diagram of the washing unit

Fig. 2. Diagram of the grating unit

Fig. 3. Diagram of the dewatering unit

Fig. 4. Diagram of the sieving unit

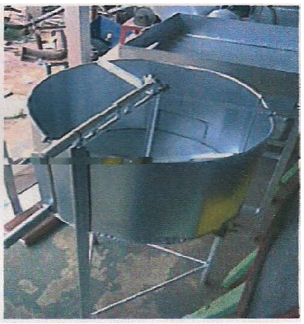

Fig. 5. Diagram of the frying unit

Results and discussion

Results were obsereved as the cassava processing operations to a stone-free Gari as shown in Tables 1, 2 and 3. The cassava processing yielded 11.5 kg, 14.4 kg and 17.3 kg of stone-free gari from 20 kg, 25k g and 30 kg of cassava roots, respectively. The grater and sieve efficiencies were 95 % and 93 %, respectively while the overall performance efficiency was 82 %.

Table 1. Evaluation of Cassava Processing Units during Gari Production for 20 kg Mass fed

	Washing Unit	**Grating Unit**	**Dewatering Unit**	**Sieving Unit**	**Frying Unit**
Mass Fed (Kg)	20	20	19	14	13
Mass Recovered (Kg)	20	19	14	13	11.5

Table 2. Evaluation of Cassava Processing Units during Gari Production 25 kg Mass fed

	Washing Unit	**Grating Unit**	**Dewatering Unit**	**Sieving Unit**	**Frying Unit**
Mass Fed (Kg)	25	25	23.8	17.6	16.3
Mass Recovered (Kg)	25	23.8	17.6	16.3	14.4

Table 3. Evaluation of Cassava Processing Units during Gari Production 30 kg Mass fed

	Washing Unit	**Grating Unit**	**Dewatering Unit**	**Sieving Unit**	**Frying Unit**
Mass Fed (Kg)	30	30	28.5	21.1	19.6
Mass Recovered (Kg)	30	28.5	21.1	19.6	17.3

This result showed that the processed cassava, Gari was found to be stone-free and of high quality. The result is interesting that it would support the aim in this study for alleviating the problems that encountered by traditional processors and possible leading to increase in production of Gari with high quality. As Sanni, *et al.,* (1994) reported that cassava roots are perishable and contain potentially toxic cyanogenic glucosides. This cassava processing may be possible to get rid of or reduction those toxic substances. Moreover, IITA (2005) and Montagnac, *et al.,* (2009) stated that the principle of preservation and processing cassava is made by fermentation to remove cyanide and produce the desirable flavours. It is then roasted to destroy enzymes and microorganisms, to drive off cyanide gas, and to dry the product. In this study, a small scale of Gari processing plant was developed that would be possible to help the farmers as stated by Davies, *et al.,* (2008) who reported that cassava processing is limited due to lack of inadequate processing equipment and low returns from small-scale processing. Thus, an improved Gari processing plant would developedas a small scale production to help the farmers and possible to promote for any kind of market oriented production of medium or large scales.

This study would become an example to solve the problems encountered by traditional Gari processors or mechanization of cassava processing operation. It would also possible to increase the production of Gari. With this, a cassava processing plant was successfully designed and developed for any market oriented production.

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(Received 22 Jauary 2010; accepted 30 May 2011)