CONVERTIBILITY OF CASSAVA RESIDUE FROM CONTINOUS STARCH EXTRACTION PROCESS INTO GARI PRODUCTS

BY

*FAITH U. BABALOLA AND FELIX AJUEBOR**

*Department of Chemical Engineering, University of Lagos
**Federal Institute of Industrial Research Oshodi, Lagos

ABSTRACT

Cassava is a starchy root crop that is in abundance in the Southern part of Nigeria. Due to its high content of starch, it is used as a raw material for continuous starch extraction process. The cassava residue paste, usually used as animal feed, is of little or no economic benefit to the industry. In this experimental work, the convertibility of this waste into "gari' (a local Nigerian diet) is studied and found to be very economically viable. The gari products (granules and flour) are of acceptable quality attributes. It is safe for consumption since its cyanide and coliform contents are nil the products however are most acceptable in mixed form.

INTRODUCTION

Cassava is one of the major staple foods in Nigeria and is eaten in various forms, the most common being its conversion to 'gari' as a local diet. Starch, both for domestic and industrial uses are presently produced from cassava by indigenous industries (Akinrele, 1965).

In the continuous extraction process for the production of starch from cassava, enormous quantities of waste is generated, which is presently only suitable for use as animal feed. The solid waste from the continuous starch extraction process is pasty, with very high moisture content, it ferments under ambient conditions and is difficult to transport to animal farms where it can be used as feed. It has been observed that due to the aforementioned, it is becoming increasingly difficult to find adequate outlets for this waste which necessitates the search for its viable use.

In this work, we report on more economically viable alternative outlets for the residue from continuous cassava starch extraction process by experimentally assessing its convertibility to edible gari and gari flour.

LITERATURE REVIEW

The Nigerian local diet, 'gari' is produced locally and is highly labour intensive. The operation involved is few and simple which gives high prospect to industrial scale design and production (Akinrele, 1967). Gari processing begins with the peeling of the cassava roots to remove the two-layer cortex. Grating of the roots is done manually over a roughly punched aluminum surface. The resulting pulp is tied in a cotton cloth bag and kept under a heavy load to press the water out for about four days. The lengthy dewatering period allows fermentation to occur which results in a sour taste highly cherished by the consumers of the final gari products especially in the Western region of Nigeria (Akinrele, 1967).

From the work of Okafor (1977), the fermentation of cassava into gari is achieved by a combined action of two micro organisms; one dovetailing into the other. Okafor (1977) reported that detoxification occurs as dewatering proceeds gradually in the cloth bag set-up which makes the process essentially aerobic. Akinrele *et. al.* (1965) reported that a low pH favours the fermentation process which is best carried out at 35°C. On the residual toxicity of gari after processing, Osuntokun *et al.* (1969) as well as Olanrewaju and Buzormenyi (1975) reported that the free cyanide in fresh cassava pulp (HCN), being non-glucocidic, diffuses into the air with some possibility of affecting the processors. Glucocidic cyanide affects its users through consumption; its poisoning effect can lead to nervous breakdown (Osuntokun *et al.* 1969; Maduagwu and Oben, 1981). According to the specification of the Standards Organization of Nigeria (2005), the maximum HCN allowed in gari is 20 ppm. Highly toxic cassava roots with about 300 mg per kilogram of pulp after processing (locally) has residual cyanide of about 14 ppm, leaving a very safe margin (Akinrele, 1964).

Chemical constituents of gari has been studied by Akinrele *et al.* (1971) and Ahonkai *et al.* (1974) while Akinrele (1967) and Banjo (1994) reported on nutritional enrichment of gari using soybean as well as vitamin additives. Heys (1983) has reported on the commercial factors affecting gari processing in Nigeria. In this work however, the focus is on converting starch residue, from industrial scale starch producing plants to gari that is comparable in acceptability with the regular locally made gari obtained from the open market. This will save much labour, boost the gari production capacity of the nation and extensively reduce wet pulp waste from starch producing industries by 100 percent

METHODOLOGY

The quantity of extractable starch present in the residue was first determined to ascertain whether recycling for further starch extraction will be profitable and also to know its nutritional value in carbohydrates, the results are shown in Table 1. Secondly, the residue was experimentally analyzed to determine its convertibility to edible gari products after it was granulated mechanically and 'garified' (fried)

Starch Content Determination

55kg of the wet cassava starch residue was screened through a 212 milli-micron mesh. The screening continued until the filtrate appeared non-turbid. The thin slurry was allowed to settle under gravity and dewatered by a screw press. The cake obtained, which had about 50% moisture content, was dried to 12% moisture content and milled to powder mechanically. The starch content was calculated and its physico-chemical properties such as colour, odour, moisture content, cyanide content etc were determined in an analytical laboratory.

Convertibility into Edible Gari Products

55kg of cassava residue was collected from a continuous cassava starch extraction process plant. The sample was fermented in a plastic tank with a well secured lid for anaerobic conditions for 100 hours. The pH of the system was determined after 72 and 96 hours of fermentation. The fermented sample was dewatered by pressing to produce the wet cake of about 50% moisture content. The cake was immediately granulated mechanically and 'garified' (fried) manually in an aluminium pot on a gas fire reducing the moisture content to about 30%. The granules were transferred to a rotary louvre drier and dried to about 14% moisture content. The gari sample was allowed to cool to room temperature before it was milled, sieved and weighed. Gari flour was removed (by sieving with 250 microns mesh) while the remainder was packaged as gari.

Samples of the two products as well as the market gari sample from Bariga market in Lagos were taken to the laboratory for physico-chemical/microbiological and organoleptic assessments. For the sensory evaluation tests, about twenty (20) people were chosen at random from different parts of Eastern and Western Nigeria. They tasted the gari and gari flour samples in their cooked and drinking forms and were then given each a questionnaire to fill. The information in the forms were collated, analyzed and rated as shown in Table 2.

EXPERIMENTAL RESULTS AND CALCULATIONS

Residual Starch Content

Wt of the sample residue = 55kg

Wt of dried cassava starch = 1.12kg

% starch = 2.04%

TABLE 1: PHYSICO-CHEMICAL PROPERTIES OF RECOVERED STARCH

PARAMETER	RESULT
Appearance	White powdery substance
Colour	White
Odour	Characteristic of cassava
% starch	75.08
% moisture	11.82
% ash	0.15
pH (10% solution)	3.25
Cyanide (ppm)	Nil
% crude fibre	0.76
% crude protein	0.59

TABLE 2: PHYSICO-CHEMICAL PROPERTIES OF THE GARI AND GARI FLOUR PRODUCED FROM THE CASSAVA STARCH RESIDUE IN COMPARISON WITH REGULAR (MARKET) GARI

PARAMETER	MARKET GARI	GARI	GARI FLOUR
Appearance	**Creamy granular substance**	**Creamy granular substance**	**Creamy particles**
Colour	Cream	Cream	Cream
Odour	Characteristic of cassava	Characteristic of cassava	Characteristic of cassava
% Starch	58.73	62.89	70.22
% Moisture	16.5	14.32	11.61
% Ash	2.09	0.08	0.34
pH (10% solution)	3.02	3.59	3.56
Cyanide (ppm)	Nil	Nil	Nil
% Crude fibre	2.16	1.12	1.29
% Crude Protein	1.26	1.05	1.14

TABLE 3: RESULTS OF THE SENSORY EVALUATION OF COOKED SAMPLES (EBA FORM) OF THE GARI AND GARI FLOUR PRODUCED FROM CASSAVA STARCH EXTRACTION RESIDUE

ATTRIBUTES	SAMPLE (A)	SAMPLE (M)	SAMPLE (X)	SAMPLE (B)
Colour/Appearance	M.A	S.A	M.A	V.A
Taste	S.A	S.A	S.A	M.A
After Taste	S.A	M.A	M.A	M.A
Flavor	S.A	M.A	M.A	S.A
Aroma	S.A	M.A	M.A	M.A
Mouldability	M.A	M.A	M.A	V.A
Mouth feel	S.A	S.A	M.A	M.A
Overall Acceptability	S.A	S.A	S.A	M.A
Ranking Value	25 2nd choice	32 3rd choice	33 4th choice	22 1st choice

KEY

V.A = very acceptable

M.A = moderately acceptable

S.A = slightly acceptable

N = not acceptable

A = gari from residue

B = gari flour from residue

M = market gari

X = mixed A and M; ratio 4:1

TABLE 4: RESULTS OF THE SENSORY EVALUATION OF GARI SAMPLES IN COLD WATER (DRINKING FORM)

ATTRIBUTES	SAMPLE (A)	SAMPLE (M)	SAMPLE (X)	SAMPLE (B)
Colour/Appearance	M.A	S.A	M.A	M.A
Taste(sourness)	S.A	V.A	S.A	S.A
After Taste	S.A	M.A	S.A	S.A
Mouth feel	S.A	M.A	S.A	S.A
Texture (grittiness)	S.A	S.A	S.A	M.A
Flavour	S.A	M.A	S.A	S.A
Aroma	S.A	M.A	S.A	N
Overall Acceptability	S.A	M.A	S.A	S.A
Ranking Value	33 4th choice	14 1st choice	24 2nd choice	29 3rd choice

KEY - As in Table 3

DISCUSSION OF RESULTS

From Table 1, it is evident that the extractable starch (2.04%) contained in the residue did not deteriorate in any form but maintained its quality. The quantity of starch obtained is however not sufficient to necessitate it's thus giving more credit to this work.

From Table 2, the physic-chemical properties of the gari and gari flour produced from the residue are slightly different one from the other. The differences are a bit significant in starch content, moisture content, ash content, percent crude fibre and percent crude protein.

Table 3 gives the sensory evaluation of the cooked samples (eba form) of the gari and gari flour products. On the overall, the gari flour (sample B) emerged as the best followed by the gari from our cassava residue (sample A). The gari from the open market (sample M) emerged as the third choice while a mixture of the gari from the starch residue with the market gari in the ratio 4:1 (sample X) emerged as the fourth choice. Looking closely at the ranking values, sample X is very close to Sample M, the difference between them is small and may be considered negligible. Sample B can be sold as a high quality product of first choice while Sample A can be blended or mixed with Sample M in the ratio 4:1. Obviously, a mixing ratio of 3: 1 instead of 4:1 will give a product of higher acceptability than the market gari (Sample

M)

Table 4 shows the result of the sensory evaluation of the gari and gari flour from starch residue in cold water (drinking form). Sample M (Market gari) emerged as the first choice while the mixed gari comes next in acceptability, though the difference is quite significant. The quality of Sample X (mixed gari) can be improved by reducing the mixing ratio to about 1:1 for the product to be used in the drinking form.

The gari products from the cassava starch extraction process residue are cyanide-free and are comparable with locally produced gari. The products have been assessed microbiologically and found to be free from lethal coliform organisms.

CONCLUSION

The cassava residue from the continuous starch extraction process can easily be processed into gari and gari flour with acceptable quality attributes. In terms of taste and after taste, the products are quite similar to the kind of gari preferred in the South Eastern and Delta areas of Nigeria. In terms of safety, the products could be adjudged safe since the cyanide and coliform contents are nil. This is a very economic use of the cassava residue waste from the continuous starch extraction process and results in 100% waste reduction.

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