LAUTECH JOURNAL OF ENGINEERING AND TECHNOLOGY 4(2) 2007: 24 – 27

EFFECT OF DEWATERING METHOD ON SELECTED PROPERTIES OF GARI

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ABSTRACT

Two of the most important steps in the 'gari' production process are the fermentation and dewatering steps during which the highest cyanide reduction occurs. 'Gari' samples were produced by dewatering the cassava mash during fermentation and after fermentation.

The samples were analyzed for their proximate composition, cyanide content and functional properties. The moisture content, bulk density and cyanide content of the sample from dewatering after fermentation were lower while the protein and ash contents were higher than that of the dewatering during fermentation method. Recorded functional properties suggest that the sample from dewatering after fermentation will take a longer time to cook and that the paste obtained from cooked 'gari' samples from the dewatering during fermentation method is firmer.

Keywords: Cassava, gari, dewatering during and after fermentation, functional properties, and fermentation.

INTRODUCTION

Cassava, a major root crop in the tropical world, serves as a primary calorie source for more than 500million people in Third World countries (IFAD, FAO; 2000). A major factor militating against the full use of cassava as food and feed is the crop's potential toxicity (Cock, 1985). This toxicity is due to the presence of cyanide in the tubers which is bound to a glucoside either as a linamarin or lataustralin (Cooke and Coursey, 1981). Consumption of high levels of Hydrogen Cyanide (HCN) from improperly processed cassava roots has been linked to many diseases such as endemic goiter and tropical ataxic neuropathy (TAN) among others.(Onabolu et al., 2002). Processing of cassava into products especially 'gari' hydrolyses the cyanogenic glycosides thus reducing the toxic content to safe levels of human consumption.

The processing steps involved in *gari* production include peeling, washing, grating, fermentation, dewatering, granulating, roasting, and cooling. Some of the bound cyanide is lost in the various steps. The ruptured cell walls during grinding result in the hydrolysis of cyanogenic glucosides by the enzyme linamarase due to contact with linamarin. During washing and fermentation, the cyanogenic glucosides are leached (Bokanga and Otoo, 1991). Reduction of HCN level in wet cassava of pulp of 72-77% was attributed to fermentation (Ngaba and Lee, 1979) while Achiwenhu and Eke (2002) reported a reduction of 81 to 87% due to fermentation and subsequent roasting. Bokanga and Otoo (1991) also reported that grinding and fermenting in water achieves the highest rate of detoxification of cassava roots resulting in a reduction of over 90% of the HCN level. Nambisan and Sudanresan (1985) observed that low rates of HCN reduction of less than 50% was observed for processes such as frying, steaming, drying, e.t.c. in which the integrity of plant cell is unaltered and enzyme linamarase is not released.

Thus the lactic acid fermentation process is one of the most important techniques in cassava processing (Odunfa, 1985). In some areas in the country, the cassava mash is dewatered continuously during fermentation while in some areas, dewatering is done after fermentation. The dewatering process is actually responsible for the quantity of liquid effluent from the cassava mash through which the free cyanide is leached. A study carried out by Onabolu et al. (2002) concluded that the method of dewatering cassava mash is an important processing factor that determines the quantity of residual cyanohydrins in gari. They observed that the highest cyanide reduction observed for both types of dewatering was recorded after 7 days of fermentation. Therefore, this study was carried out to determine the effect of the method of dewatering on selected properties of gari namely; proximate composition and functional properties of gari fermented for 7 days.

MATERIALS AND METHOD

Gari Preparation

Fresh cassava roots were peeled, washed and grated into mash using a traditional grater. Six portions of mash each weighing 5kg was put into a woven polyethylene sack with the open end tied. Heavy weights (15kg) were placed on three of the polyethylene sacks to dewater the mash continuously as the mash was fermenting. The other three sacks had no weight placed on them. The mash in these sacks, which was fermented without dewatering, was dewatered at the end of the fermentation in a mechanical press for about 30 minutes. Fermentation was carried out for 7 days in each case. After fermentation and dewatering, the mash-cake was garified (roasted) in an iron pot placed over an open fire to produce gari. Samples of gari were taken and the proximate composition, cyanogen content and functional properties were determined.

Proximate Analysis

Protein, moisture, fat, ash and crude fibre contents were determined using AOAC (1990) methods. Carbohydrate content was determined by difference. All results were performed in triplicates and the mean values recorded.

Cyanogen Content

The cyanogen content was determined by weighing 30g of gari into 250ml of cold 0.1M orthophosphoric acid. The mixture was homogenized by blending in a Waring blender followed by centrifugation at 4000rpm for 15mins. The cyanogen content of the supernatant was determined by colorimetry using a previously described method (Esser et al., 1993).

Pasting Properties

The pasting properties of the gari samples prepared at 8% (w/v) (on dry basis) were measured using a Brabender Amylograph (Brabender OHG, Germany).

Statistical Analysis

Statistical analyses were carried out using SAS software. Data were subjected to analysis of variance and Duncan's multiple range test was used for comparison of means and the significance was accepted at $P \leq 0.05$.

RESULTS AND DISCUSSION

The proximate composition of the two samples is presented in Table 1. There is generally no significant difference ($P \leq 0.05$) in the variables except for the moisture and fibre contents. The moisture content of the samples from dewatering after fermentation (TD) was lower than that of samples (CD) dewatered during fermentation probably because the use of a mechanical press at the end of the fermentation process for dewatering applied greater force than that of the 15kg weight used for dewatering during fermentation. This resulted in a greater leaching of the liquid effluent form the mash, which invariably reduced the amount of water in the gari samples after roasting. The protein, ash and carbohydrate content of the dewatering after fermentation, however, were higher than that of dewatering, during fermentation, while the fat content of the two dewatering processes was the same.

The pH values of the two samples are different (Table 2), however, the pH of the sample from dewatering after fermentation was higher, which is an indication of a lower acidity. This is similar to the observations of Onabolu et al. (2002), who also reported that micro-organisms found during natural fermentation of cassava exhibit different acid production abilities. Thus the difference in pH values may probably be due to the differences in the flora of micro-organisms that are sustained during the two dewatering processes. However it has not been established whether a higher growth of the same or the presence of different micro-organism causes the higher production of acid in the case of dewatering during fermentation. The bulk density of the sample obtained from dewatering during fermentation was higher than that of dewatering after fermentation. The moisture content of the gari produced from dewatering after fermentation was also higher than that of dewatering during fermentation. Thus increase in bulk density occurred with increase in moisture content of the gari produced, which is similar to the observations of Shittu et al. (2001) and Faborode et al. (1992).

Effect of Dewatering Method on Cyanide Content

The total HCN value was higher in samples dewatered during fermentation than that dewatered after fermentation which confirms the observations of Onabolu et al. (2002). During fermentation, hydrolysis of the bound cyanide to free HCN takes place, which reduces the cyanide content of the cassava mash (Mahungu et al., 1983). The freed HCN is then eliminated as the mash is dewatered, because of the leaching of the wastewater. Onabolu et al. (2002) observed that dewatering after fermentation decreased the cyanohydrin content which also become progressively less as the days of fermentation increased such that the lowest cyanide content was obtained after 7 days of fermentation. These workers observed that the sour taste of gari produced from dewatering after fermentation may be due to a higher organic acid content which is synonymous with lower pH value for gari. Since some cyanohydrins are stable at pH < 5.0, the low pH of the mash might have resulted in stability of cyanoydrins which reduces its breakdown causing higher cyanohydrin content in gari.

Effect of Dewatering Method on Functional Properties

The common variable used to estimate the functional properties of starch -based products is the amylographic viscosity (Ruales et al., 1993). When gari is cooked, it forms a paste hence the importance of the amylographic viscosity. The gari from dewatering after fermentation had higher peak viscosity value of 260.17 BU while the dewatering after fermentation also had the highest pasting temperature (of 63.95 °C) i.e. temperature at which rapid swelling of the starch granules took place. Samples from dewatering after fermentation look a longer time to gelatinize and thus required more heating to form a paste and also took a longer time to cook (i.e. to reach peak viscosity). The paste obtained from dewatering after fermentation had a higher percentage of starch than dewatering during fermentation which is an indication that dewatering during fermentation results in a greater modification of the starch properties and as can be seen from Table 3 it cooked faster (i.e. its time to reach peak viscosity is 5.70 min is faster than that of dewatering after fermentation). This confirms the observations of Shittu et al. (2001) that a higher level of starch damage in traditional pukuru (a fermented cassava product) resulted in a faster rate of cooking. The setback viscosity of continuous dewatering was higher than that of terminal dewatering. This is an indication of the tendency of the dough to undergo retrogadation, a phenomenon that cause the dough to become firmer (Ihekoronye and Ngoddy, 1985), thus the paste formed from cooking gari in hot water (which is *eba*) from samples of gari from dewatering during fermentation will be firmer than that from dewatering after fermentation.

CONCLUSION

In conclusion, the type of dewatering method had no significant effect on the proximate composition and the pasting properties but had a significant effect on the HCN value of the gari samples produced. This shows that the method of dewatering is an important factor to consider during the production of high quality gari.

Table 1: Proximate Composition of 'gari' samples from the two dewatering methods

	Moisture Content (%)	Protein Content (%)	Fat Content (%)	Ash Content (%)	Fibre Content (%)	Carbohydrate Content (%)
Terminal dewatering	12.40b	1.77a	0.43a	1.68a	1.83a	81.89a
Continuous dewatering	12.96a	1.69a	0.43a	1.64a	1.75b	81.63a

- Means followed by different letters in the column are not significantly different ($p \leq 0.05$) from one another
- Determination are average of triplicate samples

Table 2: Physico-chemical properties of 'gari' samples from the two dewatering methods

	Sugar (%)	Starch (%)	pH	Titratable Acidity	Bulk Density (mg/m^3)
Terminal dewatering	4.66a	60.91a	4.37a	0.14a	0.58a
Continuous dewatering	4.56b	60.13b	4.22b	0.16a	0.59a

- Means followed by different letters in the column are not significantly different ($p \leq 0.05$) from one another
- Determination are average of triplicate samples

Table 3: Functional properties of 'gari' samples from the two dewatering methods

Parameters	Peak viscosity, (BU)	Holding strength (BU)	Breakdown viscosity (BU)	Final viscosity (BU)	Set back viscosity (BU)	Time to reach peak viscosity, min	Pasting temperature, (°C)
Terminal dewatering	260.17a	221.92a	38.25a	321.25a	99.33b	5.77a	63.95a
Continuous dewatering	242.92a	216.83a	26.08a	328.17a	111.33a	5.70b	63.85b

- Means followed by different letters in the column are not significantly different ($p \leq 0.05$) from one another
- Determination are average of triplicate samples

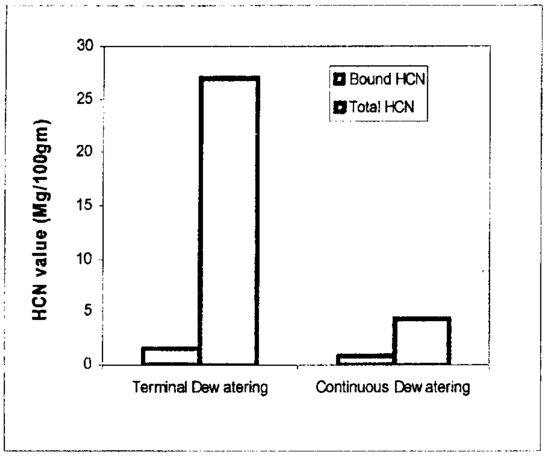

Fig 1: Effect of dewatering method on cyanide content of gari

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