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Microbiological studies and sensory evaluation of breadfruit and cassava co-fermented into *gari* analogue

H.A. Adeniran, O.M. Ajifolokun*

Department of Food Science and Technology, Obafemi Awolowo University, Ile-Ife, Nigeria

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Abstract

This study focused on the processing of breadfruit and cassava co-fermented into *gari* analogue. The microbial load was determined and the microbes associated with the fermentation were identified. The shelf life of the co-fermented *gari* analogue samples was also determined. A portion of both mature cassava tubers and matured but unripe breadfruit (*Artocarpus altilis*) was co-fermented (100:0, 0:100, 80:20, 70:30, and 60:40 Cassava: Breadfruit) to obtain *gari* analogue. The samples were evaluated for microbial loads (total viable, total yeast and mould count and total lactic acid bacteria counts). The products were subjected to sensory analyses using a 7-point hedonic scale. Data obtained were subjected to descriptive and inferential statistics. The results showed that six bacteria species were isolated from the fermenting mash, *Corynebacterium manihot, Lactobacillus plantarum, Bacillus subtilis, Bacillus coagulans, Bacillus* species and *Corynebacterium* species. Also isolated were *Saccharomyces cerevisae, Saccharomyces fragilis, Saccharomyces rouxii* and *Geotricum candidum.* Two moulds, *Aspergillus niger* and *Rhizopus stolonifer,* were found associated with co-fermented meals of cassava and breadfruit. The sensory attributes of 100% breadfruit *gari* and co-processed *gari* samples were significantly different ($p > 0.05$) from the control; the co-processed *gari* samples were however rated higher than the 100% breadfruit in terms of overall acceptability. All the *gari* samples retain their quality attributes during storage for six weeks, except for the *gari* sample with 100% breadfruit, which deteriorated after three weeks. This study established that 20% of breadfruit co-fermented with cassava yields a novel food product that compares favourably with 100% cassava *gari* in terms of microbial and sensory characteristics.

Keywords: Breadfruit; Cassava; Fermentation; *Gari* analogue; Microorganisms

1. Introduction

Breadfruit (*Artocarpus altilis*) belongs to the *Moraceae* family of plants, which consists of about 50 genera and over 1000 species. Breadfruit is propagated through stem-cuttings and the average first fruiting period of the crop is between 4 and 6 years (Amusa et al., 2002). It produces its fruits up to three times in a year and the number of fruits produced is very high. The fruit has been described as an important staple food of a high economic value. Breadfruit is one of the underutilized fruits and it differs from other fruits because it has to be cooked before consumption. Breadfruit plant is called *gbere* or *Jaloke* amongst the indigene of Ifewara in South Western Nigeria. It was restricted to the Ile-Ife axis because it was considered to be poor men's substitute for yam by other southwestern communities in Nigeria. Breadfruit is a staple food that can be prepared into various main and side dishes, i.e. it can be pounded, fried, boiled or mashed. It can also be processed into flour and used in making bread and biscuit (Amusa et al., 2002; Omobuwajo, 2003). Breadfruit is now popularly grown in other countries with tropical climates like Ghana, West Indies, Jamaica, and Sierra Leone. In the South Western Nigeria where the consumption is common, it is very important in alleviating rural poverty because it can serve as a substitute for yam. The role of breadfruit in poverty alleviation can be further expanded. One of the ways in expanding its utilization is by processing it into an already accepted popular food form, e.g. *gari* analogue, or processing into forms in which it can be used as an extender. Another area of interest to the food producer is the short shelf life

*Corresponding author.
E-mail address: oluyinka_mary@yahoo.com (O.M. Ajifolokun).

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(5 days from harvesting) of breadfruit and its high susceptibility to pest and diseases (Cook, 1975). Breadfruit is a good source of potassium, vitamin C, niacin (vitamin B3) and dietary fibre (Ragone, 2002).

Cassava (*Manihot esculenta*) is widely cultivated and consumed in tropical countries of Asia, South America and Africa, where it is a staple food for many people (Cock, 1985). Its use as human food is limited by its perishability, low protein content and potential toxicity when not properly fermented. In West Africa, cassava is popularly eaten in fermented forms such as *gari, lafun, fufu* and starch (Akinyosoye et al., 2001). Cassava contains more than one form of cyanogenic glucosides. Different varieties of cassava are generally classified into two main types: sweet cassava and bitter cassava. Sweet cassava roots contain less than 50 mg per kilogram hydrogen cyanide on fresh weight basis, whereas that of the bitter variety contains up to 400 mg per kilogram (Ray and Ward, 2006). Cassava roots can generally be made safe to eat by peeling and thorough cooking. However, bitter cassava roots require extensive processing. One of the traditional processes to prepare bitter cassava roots is through peeling, grating and fermentation, which precede cooking in order to release the volatile hydrogen cyanide gas. Another process of preparing bitter cassava roots is through cutting, soaking and boiling in water; this is particularly effective in reducing the cyanide content in cassava roots. Hence, adequately processed cassava based products with very low cyanide contents are considered safe to use by humans and for livestock feeds (Ray and Ward, 2006).

Gari, a creamy white, granular cassava-based grit is produced from freshly harvested cassava tubers, which are cleaned, grated, dewatered, left to ferment and then toasted dry in an open pan (i.e. *garified*). It is a staple food in many communities in West Africa (Akinrele et al., 1962) and could be eaten as snacks with coconut or groundnut and sugar, or it could be prepared into a semi-solid meal with hot water called *eba* and eaten with varieties of soups. *Gari* is by far the most popular form in which cassava is consumed in Nigeria and other West African countries (Ihekoronye and Ngoddy., 1985). Cassava is very poor in protein (0.7–1.2%). The formulation of cassava-based food products with supplemental protein for adults and growing children may be necessary. One way of achieving this is by blending *gari* with breadfruit, being a relatively high protein food material (Coursey, 1982). Hence, in this study, *gari* analogue was developed from co-fermented breadfruit and cassava. The product was subjected to microbiological studies with the view to determining the microbial load and microbes associated with the fermentation and establish its acceptability as a food product.

2. Materials and methods

Freshly harvested matured but unripe breadfruits and matured cassava tubers were purchased at Ita-Osa market, Ile-Ife, Osun-State, Nigeria. Microbiological media and chemicals of analytical grade were procured. Equipment were supplied by the Department of Food Science and Technology and Central Science laboratory, Obafemi Awolowo University, Ile-Ife, Nigeria.

2.1. Fermentation of breadfruit into gari

Matured green ripe breadfruits were weighed, washed, peeled and de-cored manually as shown in Fig. 1. Afterwards they were sliced manually into 1 cm-thick slices. The slices were grated mechanically and the mash obtained was placed in a bag and subjected to hydraulic press for 5 days (72 h) during which fermentation occurred and the juice drained off. The dried cake was then sieved and roasted in an open pan. The products obtained (i.e. *gari* and *gari* analogue) were packaged in polythene bags for further analysis (Awoyemi, 2012).

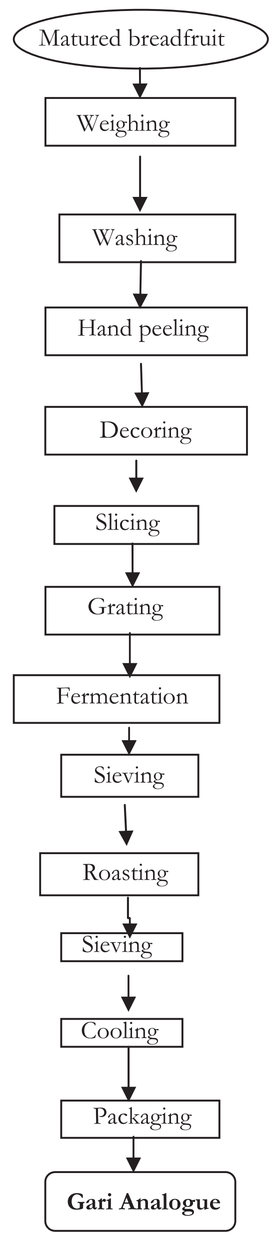

Fig. 1. Process flow of *gari* analogue from breadfruit.
Source: Awoyemi, 2012.