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Original Article

Influence of Initial Moisture Content on Some Proximate Quality Attributes of Packaged Gari in Storage

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ABSTRACT

The aim of this work is to evaluate the effect of initial moisture content on some selected proximate quality attributes of gari packaged in polyethylene and hessian bags. Sixty kilograms (60kg) of freshly harvested cassava cultivar MS6 (*Oko Iyawo*) which is common in Nigeria was selected. Gari was produced from the cassava roots using the procedure established and reported by IITA. The initial proximate properties of the gari samples fried to an initial moisture content of 17.1, 13.1 and 8.6% were determined within 24hrs of production. Fifty grams (50g) each of gari samples were packaged in the polyethylene and hessian bags. The samples were stored on a shelf at tropical ambient temperature which represents the common storage environment for sale of gari. The experimental samples were analyzed monthly for proximate quality attributes during the storage period of three months. Results showed that the initial moisture content and packaging materials had significant effects ($p < 0.05$) on the moisture and carbohydrate content of gari in storage. The packaging materials had no significant effects on the protein and fat content of gari stored at initial moisture content of 8.6 % as well as on the ash and crude fiber contents at 13.1 %. It is concluded that the fluctuations in the moisture and carbohydrate content of gari at the various initial moisture contents and package materials types will influence some other factors of deterioration which could result in contamination. It is therefore recommend that gari should be packaged in moisture proof materials such as polyethylene at a moisture content range of between 8.6 to 13.1 % since there were minimum variations in the quality attributes of gari stored at this moisture range.

Keywords: Gari, moisture content, polyethylene bag, hessian bag, proximate qualities

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INTRODUCTION

Cassava (*Manihot esculenta*) is a tuber plant which originated from South America (Hahn, 1992). The tubers are used as food source and are an important staple in many developing countries of Africa, South and Central America, India, South East Asia (Balagopalan, 2002). Cassava can grow in poor soils and can withstand drought. It is an important famine reserve crop in countries with unreliable rainfall. According to the food and agriculture organization of united global cassava development strategy, cassava is the third most important source of calories in the Tropics, after rice and corn (Adeniji *et al*., 2001).

Gari, which is a by-product of cassava is rich in carbohydrate, mainly starch and is a major source of energy. With the exception of sugarcane; gari is the highest source of carbohydrate. Cassava tubers are deficient in protein, fat, vitamins and some minerals. Gari has a calorific value of 334-360 kJ per 100g serving and is a low protein food of about 1.12%. The proximate and physical properties of gari is a function of the cassava variety, age of cassava, time of harvesting, processing methods, packaging methods, storage conditions and duration of storage (Oduro *et al*., 2000; Chuzel and Zakhia, 1991).

Adejumo and Raji (2010) carried out an appraisal of gari packaging methods in Ogbomoso, Nigeria. The objectives of the work were to appraise the various packaging materials used for gari and to suggest, safe, and affordable packaging material for gari packaging. This is with a view of reducing losses during storage and for proper planning of marketing strategies in terms of appropriate product packaging. The results showed that the packaging materials used for gari packaging are all improvised materials not specifically made for gari packaging. The loss of gari during storage was assessed on the type of storage material used, storage conditions, storage duration and the quality of gari before storage. The losses were based on change in colour, odour and taste which was a result of poor keeping quality due to the moisture uptake during merchandizing.

The effect of different packaging materials on the shelf stability of gari was studied by Ogiehor and Ikenebomeh (2006) using low density polyethylene (LDPE), high density polyethylene (HDPE), hessian bags, and plastic buckets to store gari under tropical ambient temperature for 6months. The results show that the degrees of deterioration in the carbohydrate, protein, lipid, ash and fibre content were in the other of plastic buckets > LDPE >hessian > HDPE.

Effect of moisture content and storage conditions on the storability of gari was investigated by Amadi and Adebola (2008). Yellow and white gari samples were obtained from different markets in Ilorin and stored under the same conditions using polyethylene bags, jute bags, and plastic container. The initial moisture contents of the yellow and white gari samples were 17.8% and 17.2%, respectively. Results showed that moisture content increased with time in the two samples. Air-tight polyethylene and plastic containers were observed to preserve gari better than jute bags. Nutrients component of gari also depreciated in samples stored in jute bags. Biochemical analysis revealed that starch, sugar, proteins and lipids were greatly reduced with time and increasing moisture contents. The main objective of this work is to evaluate the effect of initial moisture content and packaging types on some proximate quality attributes of gari stored for three months.

MATERIALS AND METHODS

Sixty kilograms (60kg) of freshly harvested cassava cultivar common in Nigeria MS6 (O*ko Iyawo*) was selected. Gari was produced from the cassava cultivar using the procedure established and reported by IITA (2003). The production was carried out in the Faculty of Agriculture, Research and Training Unit LAUTECH, Ogbomoso, Nigeria. Matured fresh cassava roots without rots were selected; peeled using knife and the roots were washed in clean water to remove pieces of peels, sand and other dirt. The roots were grated, packed into hessian bag and allowed to ferment for three days at room temperature. The fermented paste was then dewatered using a hydraulic jack. A woven polyester sieve was used to sift so as to remove the oversized mesh, fibrous materials and to ensure uniformity of particle size of the mesh. Frying was done in large shallow iron pan over a fire with constant stirring using a wooden paddle for 20-30 minutes. The gari samples were allowed to cool at room temperature before packaging.

The initial proximate quality attributes of the gari samples were determined within 24hrs of production. Fifty grams (50g) each of gari was packaged in the selected packaging materials: polyethylene and hessian bags. The samples were stored on a shelf at the normal tropical ambient conditions which represent the common storage environment for the sale of gari. The experiment was carried out using two different packaging types (Hessian and polyethylene bags); 3 moisture content (17.1, 13.1 and 8.6 %) and stored for 3 months at 3 replicates (2x3x3x3 =54). The experimental samples in the two packing types were analyzed monthly for some proximate qualities during the storage period of three months at three replicates. The proximate quality attributes which include moisture, crude fiber, crude protein, fat, ash and carbohydrate content were determined as prescribed by AOAC (1990). The analysis of variance of the results was determined statistically using the SPSS 15.0 statistical package and the Duncan multiple range tests were used to separate the means.

RESULTS AND DISCUSSION

The results of the mean effects of packaging materials and initial moisture content on some proximate quality attributes of packaged gari in storage are as presented in Table 1. The results show that there are significant differences ($p \leq 0.05$) in some of the quality attributes of gari packaged in the different packaging materials at various initial moisture content.

Table 1: The mean effects of packaging material and initial moisture content on the quality attributes of packaged gari stored for three months.

Duration	Parameter	Polyethylene bag			Hessian bag		
		17.1 %	13.1 %	8.6 %	17.1 %	13.1 %	8.6 %
0	Moisture content	17.1d	13.1 d	8.6a	17.1d	13.2 d	8.6a
4		16.8 c	12.9 c	9.1b	15.4 c	11.7c	9.5 b
8		13.8 b	12.0 b	9.1 b	14.3 b	11.3b	9.5 b
12		13.0a	11.8 a	9.5 c	13.7 a	10.6a	9.9c
0	Protein content	0.87a	1.07a	1.40a	0.90a	1.10a	1.37a
4		1.17b	1.27b	1.33a	1.10b	1.27b	1.33a
8		1.23b	1.30b	1.33a	1.17b	1.27b	1.30a
12		1.27b	1.30b	1.27a	1.20b	1.27b	1.27a
0	Fat (Ether extract)	1.23a	1.50a	1.87a	1.27a	1.53a	1.90b
4		1.50b	1.63b	1.83a	1.47b	1.67b	1.83a
8		1.50b	1.67b	1.80a	1.50b	1.67b	1.80a
12		1.53b	1.80c	1.80a	1.53b	1.67b	1.80a
0	Ash content	1.20a	1.53a	1.87a	1.23a	1.57a	1.87b
4		1.37b	1.63a	2.03b	1.37b	1.63a	2.03c
8		1.40c	1.60a	1.73a	1.47c	1.67a	1.73a
12		1.50c	1.63a	1.73a	1.53c	1.67a	1.70a
0	Crude Fibre	1.67a	1.77a	2.07b	1.63a	1.80a	2.07b
4		1.73b	1.77a	1.97a	1.73a	1.77a	1.93b
8		1.73b	1.83a	1.93a	1.77b	1.83a	1.87a
12		1.83b	1.87a	1.90a	1.83b	1.87a	1.83a
0	Carbohydrate	77.90b	80.93b	84.50b	77.90b	80.86a	84.47b
4		77.40a	80.80b	84.50b	78.80c	82.00b	84.17b
8		80.30c	77.53a	84.50b	77.10a	82.10b	84.27b
12		80.80d	81.73c	83.80a	80.20d	82.97c	83.53a

Means of three replicate [2]Means with the same letters for a particular measurement are no significant different ($p<0.05$).

Statistical analysis shows that packaging materials and initial moisture content has significant effects ($p < 0.05$) on the moisture content of packaged gari. There were significant decreases ($p < 0.05$) in the moisture content of the gari samples packaged in polyethylene and hessian bags at an initial moisture content of 17.2 and 13.1 % and significant increase ($p < 0.05$) for the samples at 8.6 % moisture content. The decrease was from 17.2 to 13.0 %, 13.1 to 11.8 % and 17.1 to 13.7 %, 13.1 to 10.6 % for polyethylene and hessian bags respectively (Figure 1). It, however, increased from 8.6 to 9.5 and 9.9 %, respectively, for the samples packaged in polyethylene and hessian bags. The increase and decrease in moisture content could be as a result of the attempt by the packaged gari samples to attain equilibrium with the storage environment, hygroscopic nature of gari, initial moisture content and permeability of the packaging material. This is similar to previous reports of Ogiehor and Ikenebomeh, 2006, Chuzel and Zakhia, 2006, Adejumo, 2010.

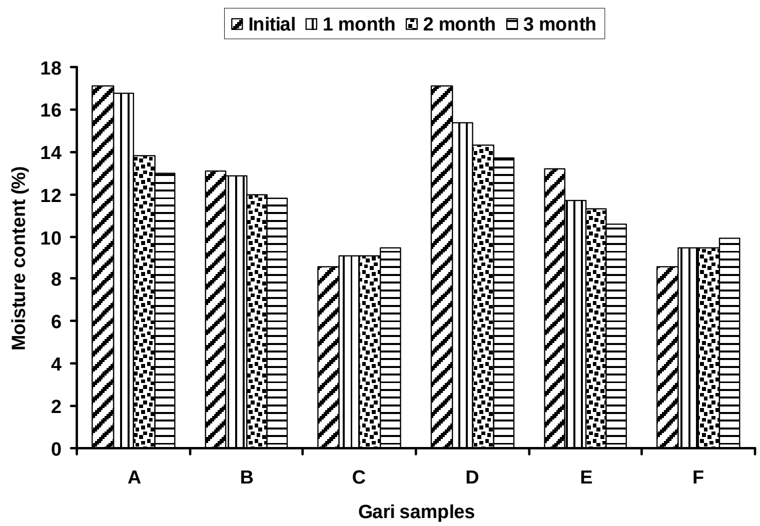

Figure 1: The effect of packaging material and initial moisture content and subsequent moisture content of stored gari

Where:
A = Gari samples stored in polyethylene bags at 17.1 % initial moisture content.
B = Gari samples stored in polyethylene bags at 13.1 % initial moisture content.
C = Gari samples stored in polyethylene bags at 8.6 % initial moisture content.
D = Gari samples stored in hessian bags at 17.1 % initial moisture content.
E = Gari samples stored in hessian bags at 13.1 % initial moisture content.
F = Gari samples stored in hessian bags at 8.6 % initial moisture content.

The packaging materials have no significant effect on the crude protein content of gari stored at an initial moisture content of 8.6 %. There was however significant increase in all the other packaged samples by the first month of storage, but then remained constant to the end of storage. The limited quantity of moisture absorbed by gari packaged and stored at 8.6 % in the two packaging types is probably responsible for the stability in the crude protein contents. It has been reported that the quantity of moisture absorbed by gari will enhance a favorable environment for microbiological growth which will increase the crude protein content of gari in storage (Ogiehor and Ikenebomeh, 2006, Adejumo, 2010).

There was no significant difference in the fat (ether extract) content of the gari packaged in polyethylene bags at an initial moisture content of 8.6%, there were however significant increase for all the other samples except for the samples packaged in hessian bag at 8.6 % initial moisture content where a decrease was observed. The fat content increases by the first month of storage for all the other samples at all the initial moisture content evaluated and then remained constant for the storage period.

The packaging materials and 13.1% initial moisture content has no significant effect ($p \leq 0.05$) on the ash content of gari. The polyethylene bag also has no significant effects ($p \leq 0.05$) on the ash content of the gari samples at 8.6 % initial moisture content. There were however significant increases ($p \leq 0.05$) in the ash content of gari packaged in polyethylene and hessian bags at initial moisture content of 17.1 % while there was a decrease for the samples packaged in hessian bags at 8.6 % moisture content.

The packaging material has no significant effect ($p \leq 0.05$) on the crude fiber content of packaged gari at 13.1 % initial moisture content. There was significant increase ($p \leq 0.05$) in the crude fiber content of samples packaged in the polyethylene and hessian bags at 17.1 % moisture content while decreases were observed for samples at 8.6 % moisture content. These results were similar to the reports of Amadi and Adebola (2008), Ogiehor and Ikenebomeh (2004).

The packaging materials and initial moisture content has significant effect ($p \leq 0.05$) on the carbohydrate content of gari. There was significant increase ($p \leq 0.05$) in the carbohydrate content for the gari packaged at initial moisture content of 17.1 and 13.1 % while there were significant decreases($p \leq 0.05$) at 8.6 % initial moisture content for the samples packaged in polyethylene and hessian bags (Figure 2). This could be due to the fact that the carbohydrate content is often determined by difference

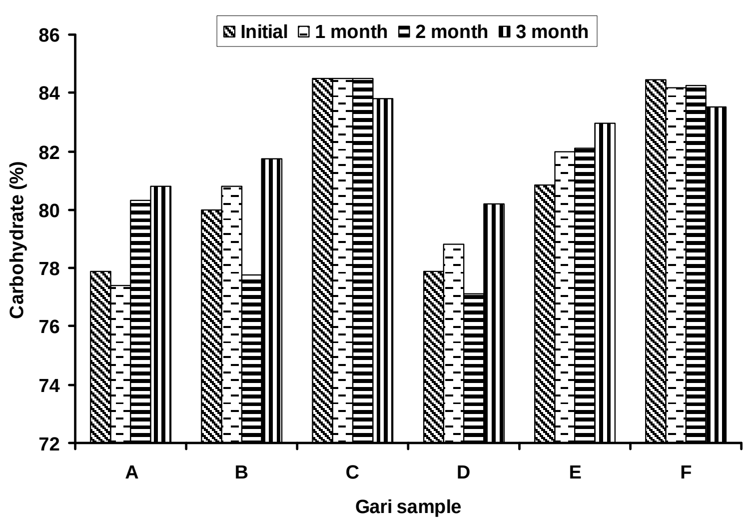

Figure 2: The effects of packaging materials and initial moisture content on the carbohydrate content of stored gari

Where:

A = Gari samples stored in polyethylene bags at 17.1 % initial moisture content.
B = Gari samples stored in polyethylene bags at 13.1 % initial moisture content.
C = Gari samples stored in polyethylene bags at 8.6 % initial moisture content.
D = Gari samples stored in hessian bags at 17.1 % initial moisture content.

E = Gari samples stored in hessian bags at 13.1 % initial moisture content.
F = Gari samples stored in hessian bags at 8.6 % initial moisture content.

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