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Full Length Research paper

Extension of shelf life of garri by hygienic handling and sodium benzoate treatment

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The effect of hygienic handling and sodium benzoate treatment on the microbial, quality and shelf stability of garri was evaluated for 14 month using standard methods. Results indicated that there were less bacteria and fungi in the hygienically handled garri at the end of the storage period than for conventionally handled samples. No growth was detected in the hygienically handled and sodium benzoate (SB) treated samples. Six bacteria and nine fungi genera were isolated from the conventionally processed and hygienically handled garri, respectively. Only *Bacillus* was isolated from the SB treated samples. The degree of deterioration recorded in the protein, lipid, ash and available carbohydrate for the conventionally handled samples were significantly more than the hygienically handled and SB treated samples. Overall sensory evaluation shows that combination of hygienic handling and SB treatment has maximum positive impact on the microbial quality, shelf stability and acceptability of garri during storage.

Key words: Garri, shelf life, conventional and hygienic handling, sodium benzoate.

INTRODUCTION

Garri, a roasted granular product from peeled, grated and fermented cassava roots (*Manihot esculenta*. Crantz), is consumed by several millions of people in West Africa (Ofuya and Akpoti, 1988). In Nigeria, its acceptability cuts across the various ethnic and socio-economic classes, making it the commonest food item. Current method of production is laborious and cumbersome and varies from one locality to another resulting in a non-uniform product with respect to quality, shelf life and safety. Furthermore, practices associated with the production, processing and handling such as drying on the floor mat after frying and the display in open bowls, bags and mat at points of sales increases microbial contamination.

Microbial deterioration of garri is of major economic concern. The main agents that contaminate and spoil garri are moulds, insects, and mites (Igbeka, 1987). Moulds such as *Aspergillus, Penicillium, Fusarium, Rhizopus, Cladosporium and Mucor* have been associated with garri during storage and distribution (Adeniyi, 1976; Oyeniran, 1978; Ekundayo, 1984). Growth of moulds in garri results in changes in the organoleptic, microbiological and nutritive quality which lead to spoilage. Deliberate efforts to control and prevent spoilage and quality changes especially during storage have received very little attention.

The application of chemical preservative such as sodium benzoate to control microorganisms in foods has been reported (Jay, 1978; Ogiehor, 2003). In addition the use of adequate sanitary and hygiene practices in combination with asceptic packaging in extending keeping quality of foods have also been investigated (Efiuvwevwere and Isaiah, 1998; Bogh-sorensen,1993). However, very scanty information is available on the

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handling practices and the use of combination of preservative techniques on the microbiology, total quality and shelf stability of garri during storage. This work was design to evaluate the effects of adequate sanitary practices, aseptic packaging (hygienic handling) and sodium benzoate treatment on the microbial quality, shelf stability and total quality of garri under tropical environmental condition.

MATERIALS AND METHODS

Garri processing

The cassava root tubers used for this study were obtained from open markets in Benin City and processed at Supply and Transport (S&T) Military Barracks Garri Processing Center, Benin City. Cassava tubers were processed into garri according to the scheme described by Adeyemi and Balogh (1985). The cassava tubers were peeled, washed and grated in a commercial grating machine. The grated cassava pulp was packed in hessian bags and allowed to ferment while dewatering gradually under pressure for 48 h. Thereafter, the fermented pulp was sieved through raphia palm net sieve, fried at about 75°C, allowed to cool to ambient (30°C) temperature and re-sieved into finer grains. Two batches were produced under the conventional condition and under strict hygienic and aseptic condition.

Hygienic handling

Clean room technology approach: Prior to processing and handling, a production room was selected. This was thoroughly washed (walls, floor, ceiling, window louvers) with detergent with the aid of pneumatic equipment and thereafter disinfected with Izal (Smithkline Beecham Nig. Plc) and left overnight. Before the fried garri sample was subjected to further handling, the production room was again thoroughly sprayed and cleaned with a solution (10%, v/v) of sodium hypochlorite (BDH, England). Similarly, the bowls, mat for spreading, raphia palm net sieving, hand gloves, mouth and nose gloves were carefully cleaned.

Aseptic packaging: The processed garri in the production room was aseptically weighed (2 kg/pack) in hessian bags (Bacco Nig. Plc) previously sterilized with the aid of industrial ultraviolet (UV) sterilizer (Model uv-2500, Rio, Italy). Thereafter the various packs were hermetically sealed with a mechanical sealing machine operated manually (Super Master, Japan). The packaged samples were kept in the laboratory at room temperature.

Treatment with sodium benzoate

A batch of the garri processed hygienically was subdivided into various sub groups and treated with 0.2% (w/w) sodium benzoated (BDH-England) and thereafter aseptically packaged as described above.

Microbial analysis

10 g from each sample were added to 90 ml of 0.1% (w /v) sterilized peptone water in a beaker and allowed to stand for 5 min with occasional stirring. Portions (0.1 ml of different serial decimal dilutions were spread-plated on nutrient agar (Oxiod) for total viable count and potato dextrose agar (Oxiod) for total fungi count. The media used were prepared and incubated according to the labeled manufacturer instructions. The colonies were enumerated and expressed as colony forming unit per gram (cfu/g) (Vanderzannt and Splittstoesser, 1992). Isolation, characterization and identification of the microorganisms were carried out for qualitative determination using colonial, morphological and biochemical characteristics (Harrigan and Mc Cance, 1976). The fungal isolates were identified based on examination of the conidial heads, phialides, conidiophores and presence of foot cells or rhizoids (Samson and Reenen-Hoekstra, 1988, Bounds et al., 1993).

Biochemical analysis

The pH was determined using the method described by Efiuvwevwere and Isiah (1998) by blending 10 g each sample in 10 ml sterilized distilled water and using a referenced glass electrode pH. Titratable Acidity was determined by titrating 0.1 N sodium hydroxide against 10 ml of sample (supernatant of garri soaked in water) using phenolphthalein as indicator (AOAC, 1990) . Moisture content, crude protein, lipid, available carbohydrate, and ash content were determined according to the methods described by AOAC (1990).

Sensory evaluation

The sensory quality (general acceptability) was assessed based on parameters such as taste, colour/appearance, flavour, mouth feel, swelling index and draw ability. Using a nine point hedonic scale a ten member panel who consumes garri on a regular basis was used to score the various quality attributes for overall acceptability.

Data analysis

The various data obtained were subjected to statistical analysis of mean, standard deviation and ANOVA and the significant differences of mean determined at (p 0.05)

RESULTS

The effects of hygienic handling and sodium benzoate (SB) treatment on the total viable count (TVC) and types of microorganisms associated with garri during storage at 30.0±2°C are shown in Tables 1 and 2. In general, microbial counts increased up to the 6 or 8th month and thereafter start to fall for the conventionally treated and hygienic garri. However, no growth was detected in the SB treated samples till the 6th month (Table 1), but this was not sustained. Fewer bacteria and fungi genera (3 each) were isolated from hygienically handled samples as opposed to 6 bacteria and 9 fungi genera isolated from the conventional samples. Only one genus (*Bacillus*) was isolated from SB treated samples (Table 2).

The degree of deterioration recorded for protein, lipid, ash and available carbohydrates detected in the conventionally handled samples was significantly different ($p<0.05$) from the values recorded for the hygienically handled and SB treated samples (Table 3). The change in moisture content, pH and titratable acidity for the different garri samples are also recorded in Table 3.

Table 1. Changes in the bioload Log_{10}(cfu/g) of garri during storage at 30±2°C samples.

Period of storage (Months)	TVC					
	Conventional		Hygienic		H + SB	
	Bacteria	Fungi	B	F	B	F
0	0.93± 0.03	0.68±0.02	ND	ND	ND	ND
2	1.67± 0.1	3.18±0.2	0.30±0.1	0.77±0.03	ND	ND
4	3.92± 0.5	4.34±0.2	1.63± 0.2	2.25± 0.1	ND	ND
6	4.83± 0.2	6.92±0.5	3.88±0.4	4.15± 0.5	ND	ND
8	4.10±0.3	6.6± 0.2	3.41± 0.2	4.64±0.4	0.60±0.01	ND
10	2.81±0.2	4.65±0.1	2.38±0.1	3.81±0.2	0.30±0.01	ND
12	2.57±0.1	3.16±0.2	2.20±0.2	3.65±0.5	ND	ND
14	1.07±0.02	1.30±0.1	0.95±0.01	1.20±0.1	ND	ND

Each value is the overall mean ± standard deviation for duplicate experiments.
ND = Not detected.
TVC = Total viable count.
B = Bacterial.
F = Fungi.
SB = Sodium benzoate .

Table 2. Microorganisms isolated from differently handled garri samples during storage at 30±2°C.

Microorganism	Samples		
Bacterial Group	**Conventional**	**Hygienic**	**Hygienic + SB**
Bacillus subtilis	+	+	+
Streptococcus lactis	+	+	-
Staphylococcus epidermidis	+	+	-
Staphylococcus aureus	+	-	-
pseudomonas aeruginosa	+	-	-
Fungi Group			
Aspergillus niger	+	+	-
Aspergillus utrinum	+	+	-
Fusarium monilifarme	+	+	-
Rhizopus stolonifer	+	-	-
Botrytis cinerea	+	-	-
Aspergillus fumigatus	+	-	-
Cladosporium sp	-	-	-

+ = Isolated / present.
- = Not isolated / absent.
SB = Sodium benzoate

Overall acceptability scores of the various attributes evaluated show that hygienically handled and SB treated garri samples are presented in Table 4.

DISCUSSION

The initial increase in the total viable count (bacterial count) and fungi count till the 6^{th} and 8^{th} month of storage recorded in the conventional and hygienically handled garri samples may be attributed to nutrient availability and favorable microenvironment. While, the subsequent decrease till the end of the storage period reflects gradual nutrient depletion and the resultant negative effects of microbial metabolics or by-products. However, the lack of growth observed in the SB treated samples indicates the benefits of combination of treatment (adequate hygienic practices, aseptic packaging and the antimicrobial effect of SB). The insignificant bacteria count detected at the 8^{th} and 10^{th} months of storage suggests shows recovery and

Table 3. Changes in the quality of variously handled garri at the end of storage period (14months).

Parameters	Fresh	Conventional	(%) Diff	Hygienic handled	% Diff	Hygienic + SB treated	% Diff
pH	4.03±0.02	3.9±0.01	3.22±0.03D	3.96±0.02	1.74±0.6[1]	4.18±0.01	3.71±0.1D
TA (%)	0.01±0.00	0.4±0.00	300±10.51	0.03±0.01	200±8.5[1]	0.02±0.00	100±4.1I
MC (%)	12.06±0.0	17.57±0.6	45.68±3.11	16.95±0.8	40.04±5.5[1]	13.98±0.2	15.92±0.6I
Protein (%)	1.24±0.05	0.01±0.00	99.19±5.1D	0.08±0.011	83.5±5.1[D]	0.98±0.02	20.96±0.8D
Lipid (%)	0.89±0.03	0.03±0.001	96.62±6.1D	0.06±0.011	93.2±3.4[D]	0.68±0.09	23.59±0.5D
CHO (%)	69.75±1.25	56.80±1.10	18.56±0.5D	59.40±2.5	14.84±0.5[D]	62.7±0.8	10.04±0.3D
Ash(%)	0.64±0.00	0.27±0.02	89.06±2.4D	0.09±0.011	85.93±3.6[D]	0.62±0.01	3.13±0.2D

Each value is the overall mean ± standard deviation for duplicate experiments.
TA = Titratable acidity, MC = moisture content, CHO = carbohydrate, I = increase, ND = not detected, D = decrease.

Table 4. Overall acceptability scores of fresh and SB-treated (after14 months) garri.

Garri Sample	ATTRIBUTES						
	Taste	Apppearance	Texture	Aroma	Mouth feel	Swelling index	Overall Scores
Fresh	7.0±0.81[a]	7.20±0/55[a]	7.40±0.64[a]	7.10±0.25-[a]	6.90±0.15[a]	6.60±0.75[a]	7.13±0.53[*]
HH+SB	6.60±0.91[a]	6.80±0.70[a]	6.35±0.63[a]	6.75±0.55[a]	6.10±0.80[a]	5.41±0.61[a]	6.34±0.7

Each value is the overall mean ± standard deviation. Mean value ± standard deviation within a column with the same superscript are not significant at p = 0.05
* = Most preferred sample.
HH+SB = Hygienically handled + SB treated.

survival of injured cells while the subsequent disappearance reveals the inability of the vegetative cells to thrive in the new environment due to SB addition. Similar findings have been reported for foods preserved by combination of preservative factors (Gould, 1988; Leistner, 1994; Beuchat, 1997; Efiuvwevwere and Isiah, 1998).

The significantly fewer groups of microorganisms genera isolated from the hygienically handled garri samples as opposed to the 12 genera isolated from the conventional handled samples clearly demonstrates the importance of strict adherence to standard hygienic practices in production process (Bogh-Sorensen, 1993; Efiuvwevwere and Isaiah, 1998). Furthermore, the drastic reduction to one genus in the hygienic handled and SB treated samples further strengthens the benefit of combined treatment on the microbial stability of food during storage.

The high degree of stability recorded in the biochemical quality such as protein, lipids, ash and available carbohydrates in the SB treated garri samples may be associated with the seemingly lack of microbial activities (Table 1) recorded and the benefits of the use of combined treatment in securing the total quality of foods (Leistner, 1996; Ogiehor et al., 1998; Ogiehor et al., 1999). The slight increase in pH observed in the hygienically handled and SB treated samples may be related to the presence of sodium benzoate which is slightly basic while slight decrease recorded in the conventional and hygienically handled samples may due to the microbial activities and its multiplier effects. Overall acceptability scores indicates that SB treated garri were highly acceptable even though freshly prepared garri was most preferred.

In conclusion, this work has demonstrated that combination of hygienic handling, aseptic packaging and SB treatment significantly improved the microbial quality, shelf stability of garri under tropical condition.

REFERENCES

Adeniyi O (1976). Fungi associated with deterioration of garri. Nigr. J. Plant Protection. 2: 74-77.

Adeyemi M, Balogh E (1985). Processing of indigenous fermented foods. Nigr. Food J. 3: 31-34.

AOAC (1990). Official method of analysis. 11th edition. Association of official Analytical Chemists. Washington, D.C.

Beuchat LR, Rocelle M, Clavero S, Jacquette CB (1997). Effects of Nisin and temperature on survival, growth and enterotoxin production characteristics of psychotropic *Bacillus cereus* in beef gravy. Appl. Environ. Microbiol. 63(5): 1953-1958.

Bogh-sorensen L (1993). Description of hurdles. In: Food and preservation by Combined process. Leistner L, Gorris GM (eds). Final Report FLAIR Concerted Action No. 7 Sub Group, Europe. pp. 7-24.

Bounds HC, Boyd FM, Norman JRA (1993). Laboratory Exercises in General Microbiology. 1st edition. Cambridge University Press. pp. 20-66.

Efiuvwevwere BJO, Isaiah AU (1998). Effects of hygienic handling in combination with potassium sorbate treatment and smoking on the microbial quality and shelf-stability of croaker (*Micropogonias furnieri*). Z lebensm unters forsch. 207: 13-17.

Ekundayo C A (1984) . Microbial spoilage of packaged garri in storage. Microbiol. Lett. 23: 271-278.
Gould GW (1998). Interference with homeostasis in food. In: homoeostatic Mechanisms in microorganisms. Whittenbury R, Gould GW, Boards JF (Eds). FEM symposium 170 (44): 220-228.
Harrigan WF, Mc Cance ME (1976). Laboratory methods in foods and microbiology Academic press, London. p. 410.
Igbeka JC (1987). Stimulation of moisture profile in stored garri. J. Food and Agric. 1: 5-9.
Jay JM (1978). Modern Food Microbiology. Second edition. D. Van Nostran coy. New York. p. 479.
Leistner L (1994). Further development in the utilization of hurdle technology for food
preservation. J. Food Engr. 22: 411-422
*Leistner L (1996). Food protection by hurdle technology. Bull. Japan Soc. Food Res. Prot. 2: 2-6.
Larmond EI (1977). Laboratory methods for Sensory Evaluation of foods. Food Research Institute Ottawa, Canada, Department of Agriculture Publication 1637.
Ofuya CO, Akpoti P (1988). Post processing microflora and shelf stability of garri. J. Appl. Bacteriol. 64: 289-394.
Ogiehor IS, Ohenhen RE, Okwu IG, Agbonlahor FE (1999). Production of Food Condiment (Sauce) from African Oil Bean (*Pentaclethra macrophylla*. Bentham) and preservation by combined application of temperatures and sodium chloride. Nigr. J. Microbiol. 13: 87-94.
Ogiehor IS, Owhe-ureghe UB, Momodu IO (1998). Microbial, Chemical and Organoleptic quality of palm wine preserved by combinations of preservatives. Nigr. J. Microbiol. 12: 63-68.
Ogiehor IS (2002). Extension of shelf life of Garri by combinations of preservative factors Ph.D thesis, University of Benin, Benin City. p. 189.
Oyeniran JO (1978). Mould development in garri during storage in polyethelene and hessian bags. Nigeria Stored Prod. Res. Inst. 11: 93-99.

Samson RA, Reenen –Hoekstra ES van (1998). Introduction to food-borne fungi, 2nd Edn. Central bureau voor schimmel cultures, Baarn.
Vaderza nnt C, Splittstoesser DF (1992). Compedium of Methods for the Microbiology examination of foods, 3rd Edn. American Public Health Association, Washington DC.