Pakistan Journal of Nutrition 7 (2): 381-384, 2008
ISSN 1680-5194

Effect of Cassava Variety on the Quality and Shelf Stability of Soy-Garri

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Abstract: The quality and shelf stability of soy-garri produced from four different cassava varieties were investigated. Soak-mix method was employed in the production of soy-garri. The products obtained were found to have protein content ranging from (5.43% to 6.1%) and fat content of about 4.20%. During the period of storage, the peroxide value increased from (0.03mg/g to 0.23mg/g) while the swelling capacity and water holding capacity decreased from (363% to 220%), (390% to 300%) respectively. The sensory result revealed that soy-garri produced from TMS 555 was the most accepted at $P < 0.05$ level of significance.

Key words: Soy-garri, cassava varieties, protein content

Introduction

Cassava (*Manihot esculent crantz)* is a very popular high energy root crop consumed in the tropics and many regions of the developing world. It is 7th most important crop of the world and constitutes a staple food for about 12.50% of the world population. (Hahn and Keyser, 1985). Cassava root is normally processed before consumption to detoxify, preserve and modify it (Oyewole, 1991). Several products are derived from processed cassava root. Prominent amongst these products is garri.

Garri is a granular finished product obtained by traditional or industrial processing of cassava tubers. Tuber processing consists of peeling, washing and grating followed by fermentation and dewatering in a jute bag for at least seventy two (72) hours. Thereafter, the cake formed is broken into small lumps, sieved and toasted at a temperature of about 80^{o}C until the moisture content is reduced to about ten percent. It could be eaten as snacks with coconut or groundnut, by adding cold water and sugar, or it could prepared into a dough (eba) with hot water and eaten with soup.

Garri is by far the most popular form in which cassava is consumed in Nigeria and indeed in West Africa (Ikediobi *et al*., 1980). It is consumed by both young and old more especially from the ages of four (4) months in rural areas that form the bulk of Nigerian population. However, it is very poor in nutrients especially protein (0.7 to 1.2%) (Obatolu and Osho, 1992). Prolonged consumption of garri without adequate protein intake will eventually lead to malnutrition. Therefore, providing cassava - based diets with supplemental high quality protein for adults and growing children may be necessary. One way this could be accomplished is by enriching garri with legumes such as soybean, which is very high in protein. This study is therefore aimed at determining the effect of enrichment with soybean on the physical properties, chemical properties and shelf stability of garri using different cassava varieties.

Materials and Methods

Sample preparation: The cassava used for this study was purchased from Ebonyi State Agricultural Development Programme (EBADEP), TMS 4 (2) and TMS 661. The variety of soybean used was TGX 1448-2E. The soy-garri was produced using soak mix method at a ratio of 3;7 (wt). This was then dewatered for three days, sieved, toasted and packaged in a black low - density polyethylene bag at an ambient temperature and relative humidity of 80 ± 5 between April and September. This was then taken for analysis as required.

Chemical analyses: The proximate composition as the free fatty acid and peroxide value of the soy-garri were carried out following official method of analysis of AOAC (1980). The carbohydrate content was determined by difference. The hydrogen cyanide was determined using Knowles and Wathins (1990) method of analysis.

Functional properties: The functional properties like swelling capacity; water-holdiing capacity, bulk density and particle size analyses were done according to Ukpabi and Ndimele (1990). The swelling capacity, water holding capacity and bulk density were statistically analysed using ANOVA at the end of the storage.

The sensory quality of the soy-garri was established using a 9-point Hedonic scale and the result generated analyzed at ($p < 0.05$) level of significance using ANOVA.

Results and Discussion

Proximate composition: Table 1 shows the results of the proximate composition of the soy-garri samples. The moisture content ranged from 8.40 to 10.60% with soy-garri from TMS 661 having the least moisture and that from TMS 555 the highest. The moisture content agrees with the work of Ukpabi and Ndimele (1990). This suggests that the soy-garri can keep for a reasonable length of time when stored in packaging materials that have low moisture permeability and low relative humidity since garri is hygroscopic in nature.

Table 1: Proximate composition of soy-garri

	% moisture	% Fat	% C. Protein	% Ash	% C. Fibre	CHO
TMS 555	10.60	4.10	6.17	5.00	5.16	68.17
TMS 572	10.00	4.20	5.71	5.00	5.88	69.21
TMS 4(2)	10.00	4.21	5.15	5.00	5.98	69.66
TMS 661	8.40	4.20	5.43	5.00	6.01	70.96

Table 2: Chemical properties of soy-garri

	Hydrogen Cyanide Mg/kg	Free Fatty Acid (%)	TTA%	Peroxide value mg/g
TMS 55	6.58	2.33	0.20	0.05
TMS 572	6.08	2.36	0.24	0.07
TMS 4 (2)	5.32	2.38	0.18	0.03
TMS 661	7.17	2.36	0.23	0.05

The fat contents of the samples were high (4.20%) compared to normal fat content of garri (0.10%). This could be attributed to the soybean seed added which is an oil seed. According to Akinrele *et al.* (1962), garri should have fat content of about 0.1%. However, the samples under investigation had fat contents ranging from 4.10% for soy-garri from TMS 555 to 4.21% for soy garri from TMS 4(2).

The crude fibre of the samples was high. Nigerian Industrial Standard, NIS (1988) recommended that garri should have crude fibre of less than 2.0%. However, the samples had crude fibre values ranging from 5.16 to 6.01% for garri from TMS 555 and TMS 661 respectively. Ukpabi and Ndimele (1990) found that market garri had a crude fibre range of 0.5 to 3.0%. the increased fibre content could be attributed to the improved varieties of cassava used.

The protein content ranged from 5.15 to 6.17% for all the samples. According to Obatolu and Osho (1992), garri should contain 0.7 to 1.2% protein. This increase in protein content is a result of soybean added. The difference in protein observed in samples could be attributed to the varieties of cassava used since the same variety of soybean was used in the processing.

The mineral levels of the soy-garri samples increased with the fortification. They had ash contents of 5.0% for all the samples. According to Akinrele *et al.* (1962) garri samples should have ash content of about 0.90%. this increase in the ash content may be due to the fortification with soybean.

The carbohydrate contents of the garri samples were very high with soy-garri from TMS 661 having the highest carbohydrate value of 70.96%.

Chemical properties: Table 2 shows the results of some chemical analyses of the Soy-garri. The total cyanide levels are relatively low. This could be attributed to the varieties of cassava used in the processing. The values ranged from 5.32 mg/kg for TMS 4(2) to 7.17 mg/kg HCN for TMS 661 with soy-garri from TMS 661 having the highest value of HCN. This work is in agreement with the report of Ukpabi and Ndimele (1990) who established that garri should have total hydrogen cyanide level of 1.7 to 8.5 mg/kg. Thus, this soy-garri having relatively increased protein content and low cyanide level can be consumed without deleterious effects.

The total titrable acidity expressed as percentage lactic acid of garri ranged from 0.18 to 0.24% for soy-garri from TMS 4 (2) and TMS 572 varieties respectively. According to Nigerian Industries Standard, NIS (1988), total titrable acidity of garri samples should be less than 1.0%. it follows then that the period of fermentation of the soy-garri was adequate.

Free fatty acid (FFA) values of soy-garri decreased from their average value of 2.23% to 0.77% within the period of storage while the peroxide values increased with storage time. This implies that prolonged storage might lead to oxidative rancidity, which can cause off-flavour in the garri samples.

Physical characteristics: Table 3 shows the results of the physical characteristics of the soy-garri over five months storage. Swelling capacity is a function of the starch content and it is dependent on the weak internal bonding of amylose and amylopectin content of the starch (Ayernor, 1979). According to Ingram (1975), good quality garri should have a swelling capacity value between 300 and 500% volume increase. The swelling indices ranged from 300% to 363% for soy-garri from TMS 555 and TMS 4 (2) varieties respectively. These values decreased with time of storage. However, soy-garri from TMS 4 (2) maintained swelling capacity of 300% at the end of storage. The decrease in swelling capacity could be attributed to retro gradation of the starch with storage time.

Water holding capacity could be used to modify the textuare of food products. The result revealed that soy-garri samples from TMS 4 (2) had the highest value of 390%. There was total decrease in the water-holding capacity but there was no significant difference between varieties.

Particle size of food samples plays a vital role in the water holding capacity. Soy-garri from TMS 4 (2) had greater particle size and had the highest water holding capacity as well as swelling capacity. From Table 3, the swelling capacity and particle size are strongly correlated [0.91,0.93,099 and 0.86 for TMS 555, 572, 4 (2) and 611 respectively]. Thus, the swelling capacity is a function of the particles size of the garri samples.

The bulk density of 0.57 g/cm^3 to 0.66 g/cm^3 is within the limits reported by previous workers. According to Ukpabi

Table 3: Functional properties of soy-garri

		Months of storage					
Samples	Parameters	0	1	2	3	4	5
TMS 555	SWELLING	300^{b}	300^{a}	280^{b}	270^{c}	261^{a}	220^{c}
TMS 572	CAPACITY	303^{b}	300^{b}	291^{c}	280^{b}	270^{c}	264^{a}
TMS 4(2)	(%)	363^{a}	341^{b}	321^{a}	311^{a}	300^{b}	300^{b}
TMS 661		362^{a}	341^{b}	321^{a}	311^{a}	298^{b}	261^{a}
LSD		15.56	9.50	5.84	6.69	7.27	10.35
TMS 555	WATER	351^{a}	350^{b}	340^{a}	329^{b}	310^{c}	300
TMS 572	HOLDING	361^{c}	350^{b}	350^{c}	340^{a}	320^{d}	310
TMS 4(2)	CAPACITY	390^{b}	380^{a}	350^{c}	340^{a}	330^{d}	320
TMS 661	(%)	350^{a}	350^{b}	340^{a}	328^{b}	310^{c}	300
LSD		5.84	1.49	0.74	5.52	1.27	ns
TMS 555	BULK	0.57^{b}	0.56^{c}	0.55^{a}	0.53^{b}	0.53^{a}	0.51^{c}
TMS 572	DENSITY	0.60^{c}	0.59^{a}	0.58^{b}	0.57^{c}	0.55^{b}	0.55^{a}
TMS 4(2)	g/cm^3	0.67^{a}	0.66^{b}	0.65^{c}	0.64^{a}	0.62^{c}	0.61^{b}
TMS 661		0.66^{a}	0.66^{b}	0.65^{c}	0.63^{a}	0.63^{d}	0.60^{b}
LSD		0.02	0008	0.02	0.02	0.2	0.009
TMS 555	AVERAGE	0.85	0.79	0.71	0.69	0.66	0.62
TMS 572	PARTICLE SIZE	0.77	0.74	0.67	0.65	0.59	0.58
TMS 4(2)	(MM)	0.86	0.85	0.77	0.75	0.73	0.71
TMS 661		0.80	0.79	0.70	0.65	0.65	0.65

Values in the same column with the same letter are not statistically different at $p < 0.05$.

Table 4: Effect of storage on the free fatty acid and peroxide value of soy-garri

		Storage period in months					
		0	1	2	3	4	5
TMS 555	FREE FATTY	2.33	2.07	1.56	1.30	1.04	0.78
TMS 572	ACID (%)	2.36	2.10	1.57	1.31	1.05	0.79
TMS 4(2)		2.38	2.12	1.61	1.35	1.09	0.83
TMS 661		2.36	2.08	1.61	1.33	1.05	0.77
TMS 555	PEROXIDE	0.05	0.07	0.12	0.18	0.22	0.23
TMS 572	VALUE mg/g	0.07	0.10	0.13	0.17	0.20	0.22
TMS 4(2)	(%)	0.03	0.03	0.09	0.13	0.15	0.19
TMS 661		0.04	0.05	0.12	0.15	0.18	0.20

Table 5: Sensory evaluation result

Samples	Colour	Texture	Taste	Odour	General Acceptability
TMS 555	1.9^{a}	5.2	5.5^{a}	6.1^{a}	2.6^{ed}
TMS 572	5.9^{b}	3.7	4.8^{ab}	4.95^{ab}	5.1^{a}
Tms 4(2)	4.8^{b}	3.9	5.1^{ab}	4.5^{b}	4.1^{ab}
TMS 661	3.5^{c}	4.5	4.6^{abc}	4.95^{ab}	3.1^{bc}
Control	1.8^{a}	3.2	3.1^{c}	1.9^{c}	1.5^{d}
LSD	1.19	n.s	1.83	1.35	1.11

Values in the same column with the same letter(s) are not statistically different at $p < 0.05$.

and Ndimele (1990), good garri should have bulk density of $0.568 g/cm^3$ to $0.908 b/cm^3$. Ayernor (1979), reported that bulk densities of the soy-garri samples decreased with time. Besides, the particle size of the soy-garri ranged from 0.77 mm for TMS 572 to 9.86mm for TMS 4 (2). There was a decrease in the particle size with time. At the end of the storage, TMS 572 had a particle size 0.58mm while TMS 4 (2) had 0.71mm particle size. According to Ukpabi and Ndimele (1990), garri with small aggregate sizes have lower moisture content and can keep for a longer period. Thus, the particle sizes of the soy-garri were within acceptable range.

From Table 5, the sensory result reveled that there was no significant difference in tastes of the garri samples. In terms of colour, the colour of the soy-garri from TMS 555 was statistically different ($p<0.05$) from others. It had a colour, which was more acceptable. The textures of the soy-garri samples were not significantly different. This could be attributed to the size of the sieve used and as well as the toasting temperature. However, the sensory evaluation revealed that at the end of the storage, soy-garri TMS 555 was the most accepted of all the samples while samples 572 and 4 (2) were the least accepted.

Conclusion: Soy-garri produced from different cassava varieties had improved protein content and low total hydrogen cyanide level. Although TMS 4 (2) has the least protein, its low total hydrogen cyanide value is highly desirable. The physical qualities like swelling capacity, bulk density, water holding capacity and particle size decreased with storage time. However, the swelling capacity of soy-garri from TMS 4 (2) was statistically different. The incorporation of soybean in garri did not affect the texture of the garri ($p<0.05$). In all the varieties tested, the qualities of the garri were accepted.

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