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Quality evaluation of 'gari' produced from cassava and sweet potato tuber mixes

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The quality evaluation of gari produced from mixes of cassava (*Manihot esculenta,* Crantz*)* and Sweet potato *(Ipomoea batatas)* tubers were investigated and reported. This is done to allow for the establishment of the best mixes of cassava and potato tubers to be adopted in the composite gari produced. Gari was produced from mixes of cassava and sweet potato tubers at different ratios (100:0, 90:10, 80:20, 70:30, 60:40, and 50:50 cassava and potato tubers, respectively). The samples of gari produced were subjected to various analyses like nutritional, antinutritional and organoleptic assessment using standard methods. The outcome of the proximate analysis revealed a gradual increase in the protein contents (1.27± 0.003 to 2.30 ± 0.110%,), ash (0.12 ± 0.020 to 0.48 ± 0.020%), fat (1.08 ± 0.030 to 1.54 ± 0.030%) and crude fibre (1.24 ± 0.004 to 1.48 ± 0.020%) as the percentage of sweet potato increased in the produced gari. There was reduction in the carbohydrate contents (84.55 ± 0.004 to 82 ± 0.030) with the increase in the percentage sweet potato. The moisture content was within the range of 10.20 ± 0.020 to 11.75 ± 0.030%. For the antinutritional factors, all the components (tannins, phenols, saponnins, glycosides, trypsin, phytate and oxalate) determined were at a very low concentration (maximum of 0.01 g/100 g and 0.012%). The sensory evaluation showed that sample A was scored best in all the quality attributes (color, taste, texture, chewability, soakability and the overall acceptability) except for the aroma where sample C scored highest. Conclusively, from the results obtained in this work, sweet potato addition in gari production can be said to give positive effects on the nutritional qualities of the product but does not really add to the organoleptic properties.

Key words: Cassava, sweet potato, nutritional, anti-nutritional, organoleptics.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz*)* also variously known as *manioc, mandioca, yuca*, is the most important food in terms of dietary carbohydrates. Many households eat cassava daily in various forms (Okechukwu and Okoye, 2010). Gari is a dry granular meal made from moist, lactic acid fermented product of cassava roots. Gari can be processed with carotenoid-rich palm oil (yellow gari) or without palm oil (white gari). This product is widely acceptable and consumed by both the rich and poor in Nigeria. Some local people take the product in dry form as snacks more or less, it can be soaked and taken in complement with mashed beans, beansball, groundnut

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cake, mashed with beans as porage, it can be pounded or reconstituted into a paste product called eba and consumed with stew or soup in dry form among others.

One major factor limiting the consumption of cassava products such as gari is the potential toxicity of the products of its cyanogenic glucosides. Increased intake of cyanide in the diets of man can lead or contribute to goiter, cretinism, paralysis and neurological disorders.

Ordinarily, the various steps employed during the processing of gari such as peeling, washing, grating, fermentation, dewatering and roasting minimizes the residual cyanide contents of the product. In addition, the traditionally methods of gari production involves fermenting the grated cassava roots (slurry) for three days (72 h) during which the cyanides (linamarin and lotaustralin) are hydrolyzed by an endogenous enzyme (linamarase) to yield hydrocyanic acid (HCN) which has low boiling point and escapes from the dewatered pulp during toasting rendering the product (gari) safe for human consumption (Chijioke et al., 2010). However, this is not usually the case as many processors cut corners to achieve quick turnover leading to several gari samples containing cyanides in excess of the maximum World Health Organization recommended safe level of 10 ppm. In addition, processing steps such as sun-drying and solid-state fermentation coupled with storage of gari could provide favourable conditions for the growth of moulds and the production of mycotoxins (Abu et al., 2010).

Sweet potato is a nutritionally rich root tuber. It is a good source of vitamin A (Sobukola et al., 2010). Nigeria has a population of over 160 million people and ranks first in Africa and 9th in the world population size. The world Health Organization has classified Nigeria among the 34 countries in the world with a problem of xerophthalmia and nutritional blindness (WHO/UNICEF, 1994). The vitamin A deficiency affects about 9.2% of children and 7.2% of mothers (UNICEF/FGN, 1994). In recognition of this, the Federal Government of Nigeria, UNICEF and other agencies set in place several programmes to correct the vitamin A deficiency (VAD) problem (Uzomah et al., 2006). Nigeria has a high potential to improve intake of vitamin A by the target population without changing the dietary and cultural habits when appropriate food vehicle is identified and used (Nnayelugo, 1999). Gari is a product that is largely processed at the household level and widely consumed by the population; the use of sweet potato and cassava to produce gari as a possible vehicle for vitamin A and other nutritional attributes will be a very good exploitation.

MATERIALS AND METHODS

Cassava and sweet potato tubers were collected from a farm at Iree in Osun State and Offa in Kwara State, Nigeria, respectively. The tubers were differently sorted, washed and peeled. The differently peeled tubers were cut into smaller sizes, grated, dewatered and fermented. The fermented mashes were mixed in ratios; 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50 cassava to sweet potato slurry, respectively. These mixes were garified by toasting in a deep frying pan. The toasted mash (gari) were cooled in an aluminum tray and packaged differently for analyses.

Proximate analysis

Proximate analysis was carried out on the samples and the control using the method described by Association of Analytical Chemist (AOAC, 1990). The ash content was determined with the use of muffle furnace and moisture content was determined by oven drying method. The crude fat was extracted using solvent extraction, crude protein was determined by Kjeldahl method and the value obtained was multiplied by 6.25 and carbohydrate determination was determined by difference.

Anti-nutritional factors determination

The anti-nutrients levels in the samples of gari produced (oxalate, phytate, tannins, trypsin inhibitors, phenol, saponin and glycoside) were determined using the rapid test method of AOAC (2000).

Organoleptic assessment

The organoleptic assessment was carried out using multiple paired comparisms with a 9-point Hedonic scale of preference and the results generated were analyzed using analysis of variance (ANNOVA) (Figure 1).

RESULTS AND DISCUSSION

Proximate composition

The results of proximate analysis on the gari samples produced are as presented in Table 1. The components determined were: moisture contents, proteins, fats, ash, carbohydrates, and crude fibre.

The moisture content ranged between 10.20 to 11.74% with sample A having the highest value. This range compared reasonably well with the maximum 12% recommended for shelf stable gari (Abu et al., 2006). Ash, fat, crude fiber and crude protein were significantly increased as the proportions of sweet potato tubers added to cassava tubers increased. The samples with sweet potato recorded higher values for protein. The values ranged between 1.40 and 2.38% with sample F having the highest value. The protein content for control sample was minimal (1.27%). The nutritional value of protein in sweet potato gari was a combination of two factors: total essential amino acid content of the protein and protein digestibility which is an indicator of the availability of the essential and non-essential amino acid in the protein (Ihekoronye and Ngoddy, 1985). This fact clearly shows the reason why the protein value gradually increased with the addition of sweet potato. Fat content was found on the increase with more sweet potato addition. Sample A, which was the control, had the least value of fat (1.08%) and sample F had the highest value (1.54%). The ash content of the control sample was 0.12% and sample F had the highest value (0.48%). Ash content of food product

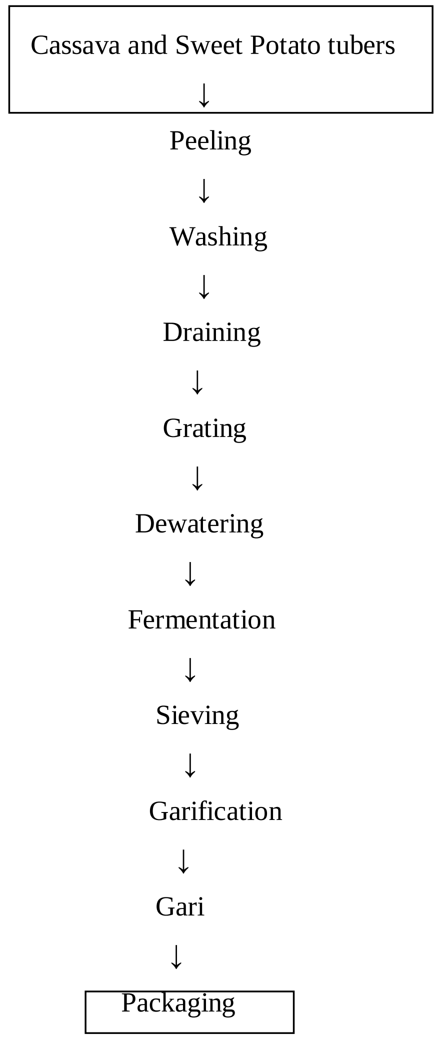

Figure 1. Processing of 'gari' from cassava and sweet potato tubers.

Table 1. Proximate composition of the composite gari.

Sample	Proximate composition (%)					
	Protein	Moisture	Ash	Fibre	Fat	CHO
100% CT	1.27±0.03	11.74±0.03	0.12±0.02	1.24±0.04	1.08±0.03	84.55±0.04
90:10 (CT:SPT)	1.40±0.01	10.20±0.02	0.22±0.03	1.28±0.02	1.17±0.02	85.73±0.04
80:20 (CT:SPT)	1.64±0.03	11.50±0.01	0.32±0.01	1.42±0.02	1.30±0.01	87.10±0.04
70:30 (CT:SPT)	1.92±0.03	10.75±0.04	0.38±0.01	1.53±0.01	1.35±0.02	84.07±0.02
60:40 (CT:SPT)	2.14±0.02	11.40±0.04	0.42±0.01	1.64±0.01	1.47±0.02	82.93±0.03
50:50 (CT:SPT)	2.38±0.01	11.60±0.01	0.48±0.02	1.48±0.02	1.54±0.03	82.52±0.03

CT, Cassava tuber; SPT, sweet potato tuber.
Values are mean ± standard deviation of the replicate determinations.

is an indication of the mineral content of the food products; values close to 0.5% ash contents is a good representation of minerals content (Adeleke and Odedeji, 2010). As a result, samples E and F were of good value with reliable representation. The crude fiber content ranged between 1.28 and 1.64%. Control sample recorded 1.24%. As more sweet potatoes were added, the crude fiber was on the increase. Crude fiber through its water

Table 2. Anti-nutritional composition of the composite gari.

Sample	Antinutritional composition (g/100 g)						
	Tannins	Phenol	Saponin	Glycoside	Trypsin	Phytate	Oxalate
100% CT	0.010	0.003	0.012	0.004	0.004	0.011	0.009
90:10 (CT:SPT)	0.010	0.002	0.006	0.003	0.003	0.008	0.006
80:20 (CT:SPT)	0.012	0.003	0.004	0.002	0.003	0.004	0.003
70:30 (CT:SPT)	0.007	0.002	0.004	0.002	0.003	0.005	0.002
60:40 (CT:SPT)	0.008	0.002	0.003	0.001	0.002	0.003	0.002
50:50 (CT:SPT)	0,000	0.002	0.003	0.001	0.002	0.002	0.002

CT, Cassava tuber; SPT, sweet potato tuber.

Table 3. Sensory evaluation for the composite gari samples.

Parameter	100% CT	90:10 (CT:SPT)	80:20 (CT:SPT)	70:30 (CT:SPT)	60:40 (CT:SPT)	50:50 (CT:SPT)
Colour	7.88	3.96	3.99	3.90	4.13	4.13
Aroma	6.92	6.28	6.94	6.50	6.93	6.94
Taste	7.60	5.96	5.96	5.96	5.62	6.96
Texture	6.96	5.80	5.90	5.92	5.90	5.86
Chewability	7.24	5.64	5.64	5.70	5.68	5.68
Soakability	7.16	5.68	5.72	5.70	5.60	5.64
Overall acceptability	7.25	6.12	6.20	6.10	6.22	6.32

CT, Cassava tuber; SPT, sweet potato tuber.

absorption capacity has been found to aid peristalsis movement of food through the digestive tract (Abu et al., 2010). The carbohydrate content revealed that the sample C had the highest value of 87.10%. However, all the other samples had appreciable quality of carbohydrate with the sweet potato addition. All the values were close which ranged between 82.52 and 87.10%. Nutritionally, these samples stood out and equally had higher proxymate constituents than both the control and other samples. Addition of sweet potato to cassava tuber gari in this regard, therefore leads to production of more nutritious and nourishing product.

Antinutritional factors

The results of the anti-nutritional content of gari produced from cassava and sweet potato tubers are shown in Table 2. The results of the anti-nutrients determined (tannin, phenol, saponin, glycoside, trypsin, phytate and oxalate) were insignificant. This result correspond to the report of Agte et al. (1999) that method of processing such as soaking, autoclaving and cooking has an effective result in reducing the antinutritional factors of foods. Hydrocyanic glycosides, a toxic compound which can be easily destroyed by cooking (Miller, 1990) were significantly reduced after processing. Likewise, other anti-nutrients were found below the permissible level (1%), showing that the samples were fit for consumption (Peregrine, 1983).

Organoleptic assessment

Table 3 shows the mean sensory scores obtained from the sensory evaluation of the gari samples. From the results obtained, the values were significantly different at 5% level for colour, aroma, texture, chew ability, soak ability and over all acceptability. Generally, the ratings of the gari samples for sweetness were poorly rated in sensory attributes. This may be due to dark colour of the products that may have been impacted by enzymatic browning reaction that might have taken place during the processing. In addition, it may be due to the naturally present polyphenolic compounds in sweet potato (Ihekoronye and Ngoddy, 1985).

Conclusion

Producing gari from sweet potato and cassava tubers mixes brought a significant improvement on its nutritional composition and the production was technically feasible. Conclusively, from the results obtained in this work, gari production using the ratio of 50 to 50% cassava: sweet potato, respectively can be said to give positive effects on the nutritional qualities of the product but does not really add to its organoleptic properties.

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