ASSET Series B (2007) 6 (1): 41-49

ASSET
An International Journal

EFFECT OF CHEMICAL PRETREATMENTS ON THE PHYSICO-CHEMICAL AND SENSORY ATTRIBUTES OF SWEET POTATO-GARI

L.O. SANNI, *J.M. BABAJIDE AND M.W. OJERINDE

Department of Food Science and Technology, University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria
*Corresponding author

ABSTRACT

The effect of addition of sodium metabisulphite, NaS_2O_5 (2.5 and 0.5%) and lime juice (2.5 and 0.5%) on the quality of sweet potato-gari was investigated. Untreated sweet potato-gari and cassava-gari served as control. Moisture content of cassava-gari and sweet potato-gari ranged between 7.95 and 8.80% db. The pH and TTA values of sweet potato-gari were 5.8 to 6.0 and 0.94 to 0.99, respectively, while cassava-gari had pH 4.42 and Total Titratable A of 1.11% lactic acid. Swelling capacity showed that sweet potato-gari pretreated with 2.5% NaS_2O_5 had the lowest value of 252% compared to those pretreated with 0 .5% lime with highest value of 301% while cassava-gari recorded 430%. Sample from 2.5% NaS_2O_5 treatment had the highest average particle size index followed by sample treated with 2.5% lime having the lowest. There were significant differences ($P<0.05$) in the sensory attributes of sweet potato-gari and cassava-gari also in the treated sweet potato-gari and untreated sweet potato-gari samples. The gari samples containing 2.5% lime juice and 0.5% Sodium metabisulphite were comparable to colour of cassava-gari.

Key words: Pre-treatment, Quality, Sweet potato-Gari.

INTRODUCTION

Sweet potato (*Ipomoea batatas* Lam) is a hardy and nutritious staple food crop, which is grown throughout the humid tropical and subtropical regions of the world, from sea level to 2,700m altitude (Sullivan *et al*., 1997). It is a perennial plant of the family convolvulaceae, with long trailing vines and leaves, which vary in shape from simple to deeply lobed. Like cassava, it can be grown in semi-arid condition, but it has greater tolerance than cassava to the low temperature encounter at high altitude, and to heavy soils (Woolfe, 1992; Sullivan *et al*., 1997). However, it is intolerant of water logging, and is usually grown on ridges or mounds.

One of the world's highest yielding crops in the tropics, sweet potato has a total food production and food value per unit area (7-25t/ha) exceeding that of rice while requiring relatively low fertilizer inputs (O'Hair, 1990). Sweet potato ranks high in energy, carbohydrate, vitamin A, vitamin C, Calcium and Iron (Onwueme, 1982; Woolfe, 1992). It is a source of fibre, which appears to play a favourable role in reducing blood cholesterol level. Sweet potato also contains a significant quantity of the anti-oxidant nutrients ß-carotene, vitamin C and

ISSN 1595—9694

vitamin E, thus, inhibit the formation of free-radicals. The latter may be implicated in the development of coronary heart disease and cancer, chronic diseases (Woolfe, 1992).

Sweet potato is typically produced for food, eaten by the grower's family or locally marketed in an unprocessed form. However, an increasing volume is being processed into industrial starch, alcohol, noodles and other products especially in China. In some regions, sweet potato is also the mainstay of livestock production, utilizing both the vines and the undersized roots. In the Canet valley in Peru, sweet potato supports a modern dairy industry (Woolfe, 1992).

One of the latest innovative utilization of sweet potato in Nigeria is gari production using sweet potato. This involves the use of various unit operation processes involved in Gari production, such as peeling, washing, blanching, grating, loading into sack, pressing and fermentation, sieving, roasting and packaging (Sanni and Ikuomola, 2001). Gari is a fermented partially gelatinized granular product usually produced from cassava, which is very popular in Nigeria (Ingram, 1975; Ihekoronye and Ngoddy, 1985; Westby and Twiddy 1992; Oduro *et al*., 2000). Gari occupies an important place in the diet of the people of Nigeria and some West African countries. It is a staple food that can be purchased by any category of people in a society not withstanding the income earned.

The research carried out so far on the physical and chemical composition of sweet potato shows that it can be used for gari production, but one of the important problem in this process is the dis-colouration of the product, which occurs either during peeling, cutting and when sweet potato is subjected to high temperature during roasting. The aim of this work is to study the effect of chemical pretreatment on the physico-chemical and sensory qualities of sweet potato-gari.

MATERIALS AND METHODS

Materials and Sample Collection

Fresh Sweet potato tubers (Red skin variety) *Ipomoea batatas* were purchased from market women from the village at Lafenwa in Abeokuta, Ogun State, South West Nigeria. Fresh ripened (yellow) lime was purchased at Osiele in Abeokuta, Ogun State, Nigeria. Sodium metabisulphite, NaS_2O_5 salt was supplied by the Food Science and Technology laboratory of the University of Agriculture, Abeokuta, Nigeria.

Preparation of 0.5 and 2.5% Solutions of Lime

Fresh ripe lime/frits were washed in clean water, cut using a sharp knife and juice extracted manually (by squeezing with hands) into a clean bowl. The extracted juice was then filtered to remove seeds and fibre using a sieve of 80µm mesh size. From the filtered juice, 0.5ml and 2.5ml were pipetted into different volumetric flask respectively and made up to 100ml distilled water, i.e., using v/v measurement.

Preparation of 0.5 and 2.5% NaS_2O_5 solution

Approximately 0.5 and 2.5% of Na_2SO_5 salt were measured using a Mettler balance respectively. These were then poured into

different dry volumetric flask and made up to 100ml distilled water.

Preparation of sweet potato-gari using Sodium Metabisulphite Salt and Lime as Pretreatment

Fresh sweet potato tubers free from insect damage but without serious cut were used for this process. One kilogram of fresh sweet potato tubers were dipped completely into water and washed thoroughly to remove adhering soil from it and then transferred into a plastic basin that is filled with clean water. The tubers were transferred immediately into water after peeling to prevent oxygen from getting in contact with them thereby retarding enzymatic browning. The well-peeled sweet potatoes were placed into bowls containing the different percentages of the prepared chemicals for 1h. The tubers were then grated into a fine pulp using a gari grater. The resulting mass after grating were packed into well labeled (identifying the different percentages of treatment used) perforated sacks knotted at the open end to prevent the mass from pouring out of the bag. The bags were pressed to allow the juice containing sugar within the mass to be removed for 20min. The pressed mass that appears as a solid cake was broken up into separate individual particles both by hand and through sieves of bamboo cane. Fine particles obtained were roasted in a shallow cast iron or earthenware pan over an open wood fire. Spatula-like paddles of wood or calabash sections were used to press the sieved mass against the hot surface of the earthenware pan, scrapping it quickly to prevent burning and to stir the mash vigorously until gelatinized. The dried granules of sweet potato-gari were then packed into High Density Polyethylene bag (0.15mm) and heat-sealed with the aid of MEC Impulse sealer, ME-200H model.

Determination of Percentage Yield

According to Oduro *et al.* (2000), percentage yield of the sweet potato-gari was determined by weighing tubers of freshly purchased sweet potatoes before peeling. Immediately after roasting, the obtained gari sample was then weighed. The Percentage Yield was calculated as follows:

$$\text{Percentage Yield} = \frac{\text{Weight of unpeeled sweet potato tubers}}{\text{Weight of obtained sweet potato-Gari sample}} \times 100\%$$

Moisture content analysis

Five (5) grams of each sample were accurately weighed into a cleaned, dried and weighed glass Petri-dishes. These dishes with their content were placed inside the Gallenkamp hot air oven at a temperature of 105^{o}C for 3 h. Thereafter, they were cooled in desiccators and weighed. The dishes were then taken back to the oven and allowed to stay for 30min. This process was continued until all the samples in the dishes gave a constant weight. Therefore, the percentage moisture content was calculated using the formula:

$$\% \text{ Moisture content} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100\%$$

where, W_1 = weight of sample in dish before drying, W_2 = weight of dried sample + dish after drying (A.O.A.C, 2000).

pH Determination

Five grams of gari sample from Sweet potato was homogenized in 10ml of distilled water in a beaker. The pH of the mixture was determined manually, using Jenway 3016 pH meter.

Total Titratable Acidity (TTA)

The sample whose pH has been determined was transferred into 250ml conical flask and 15ml of distilled water was then used to wash out the beaker into the flask. The suspension was then filtered against 0.1M NaOH using phenolphthalein. The total titratable acidity was calculated as percentage lactic acid (A.O.A.C, 2000).

Average Particle Size

The particle size of the gari samples were determined based on the method of Henderson and Perry (1979) for dry flour. One hundred grams of the gari sample was sieved through a set of graded Tyler sieves of aperture sizes 0.84, 0.42, 0.21, 0.105 and 0.0525 mm using a Retsh Vibro shaker set at frequency of 50Hz for 10min. Fraction retained on each sieve was then weighed.

Swelling Capacity

This was determined based on the method of Ajibola *et al*. (1987) as modified by Natural Resources Institute (Bainbridge *et al*. 1996). A 50ml glass measuring cylinder was filled with the gari sample to the 10ml mark. Distilled water was added at room temperature (25 -27^{o}C) to give a total volume of 50ml. The top of the cylinder was tightly covered and the contents mixed by inverting the cylinder. After two minutes the cylinder was inverted again. The cylinder was then left to stand for three minutes (5min total time) and the final volume occupied by the gari recorded. Swelling capacity was determined by dividing the volume of gari in water by the initial volume of gari.

$$\text{Swelling Capacity} = \frac{\text{Volume of gari in the water}}{\text{Initial volume of gari}} \times 100\ \%$$

Sensory Evaluation

Twenty panelist that were gari eaters assessed sweet potato-gari (flour, eba or soaked type). The panelist rated the samples in terms of aroma, taste, appearance, ability to soak, mouth-feel, crispiness and colour using a 9-point hedonic scale with 1 representing 'dislike extremely' and 9 representing 'like extremely' respectively (Ihekoronye and Ngoddy, 1985). Responses of the panelists were subjected to statistical analysis.

Statistical Analysis

All data collected from experiments were subjected to analysis of variance and means were separated using Duncan Multiple Range Test (Ihekoronye and Ngoddy, 1985).

RESULTS AND DISCUSSION

The results of percentage yield and moisture content of sweet potato-gari and cassava-gari as found in Table 1, were not significantly different from each other. However, the yield of sweetpotato-gari can be relatively improved upon by using a grater that will be suitable for sweet potato tubers. The result showed that the yield was 40 to 42 % and the moisture content of

pretreated gari samples was between 7.95 to 8.80. Laryea – Brown and Anderson (1980) stated that a good quality gari should be dry and thus of low moisture content.

The pH and TTA values of sweet potato- gari pretreated with lime and Sodium metabisulphite were 5.8 to 6.0 and 0.94 to 0.99, respectively, while cassava-gari had pH 4.42 and TTA of 1.11 (% Lactic) (Table 2). It could be observed that the pH of sweet potato-gari was quite high while TTA values were lower compared to that of cassava-gari. The pH's of sweet potato-gari were above the recommended range of 3.5 – 4.5 for acid fermented products (Bainbridge *et al*., 1996) while the TTA fall within the recommended standard of 0.6 – 1.2 for cassava-gari (Oduro et al., 2000). The values of swelling capacity showed that sweet potato-gari pretreated with 2.5% NaS_2O_5 had the lowest value of 252 % compared to those pretreated with 0.5% lime with highest value of 301%. However, the values were lower when compare with cassava- gari (430%). Swelling capacity is the ability of gari to swell and this is influenced by the quantity and type of amylose and amylopectin present (Bainbridge *et a.,* 1996) in the gari. Swelling capacity is very important because it indicates the degree of gelatinization of the gari sample. Samples of 0.5 and 2.5% lime and, sweet potato-gari without treatment had a good swelling capacity.

The result of the average particle size index showed that the samples were all within close range with sample of 5.0% NaS_2O_5 having the highest average particle size index and sample treated with 2.5% lime having the lowest. This might be due to the applied local method of grating procedure and the garification process. When compared with cassava-gari, the particle sizes of sweet potato gari were far higher than expected. Oduro *et al*. (2000) reported that recommended standard for cassava-gari ranged from 3.58 to 4.47, 0.60 to 1.20%, 290 to 750% and 0.25 to 1.00mm for pH, Titratable acidity (TTA), swelling capacity and particle size, respectively.

There were significant differences ($P<0.05$) in the appearance, mouthfeel and taste of roasted cassava-gari and sweet potato-gari (Table 3). Thus, cassava-gari was the most acceptable, followed in descending order by sweet potato-gari pretreated with 0.5 and 2.5% lime and 0.5% NaS_2O_5 which are not significantly different from each other in terms of appearance, mouthfeel and taste. There was no significant difference ($P>0.05$) in the crispiness and colour of cassava-gari and sweet potato-gari pretreated with 2.5% lime and 0.5% NaS_2O_5. Untreated sweet potato-gari was the least acceptable for all the attributes measured (Table 3).

As observed from Table 4, when eba was prepared from each of the gari samples, there was no significant difference ($p>0.05$) in the appearance (colour) and aroma of cassava-gari and sweet potato-gari treated with 2.5% lime and 0.5% NaS_2O_5. The texture of eba made from cassava-gari sample was significantly different ($P<0.05$) from all the sweet potato-gari samples (treated or not treated), with the untreated sweet potato-gari having the lowest texture acceptability (Table 4). When all the gari samples were soaked in

water, there was no significant difference ($P>0.05$) in appearance and soak-ability of cassava-gari and sweet potato-gari pretreated with 0.5% NaS_2O_5. However, there was significant difference ($P<0.05$) between the cassava-gari and all the sweet potato-gari samples (treated or untreated), based on the taste of soaked gari (Table 5).

Generally, the colour of sweet potato samples made by addition of 2.5% lime juice and 0.5% sodium metabisulphite were not significantly different from cassava-gari by panelists, proving that chemical treatment can prevent discolouration observed for untreated sweet potato-gari.

CONCLUSION

It may be concluded from this study that 2.5% lime and 0.5% Sodium metabisulphite solution gave the qualities of sweet potato-gari. There was improvement in the appearances of sweet potato-gari treated with lime juice or metabisulphite solution. Further research solution could be carried out on the shelf life and economic feasibility studies of sweet potato-gari treated with lime juice and metabisulphite solution.

REFERENCES

Ajibola, O.O., Makanjuola, G.A., Almazan, A.M. 1987. Effects of processing factors on the quality of gari produced by steam gelatinization technique. *Journal of Agriculture and Engineering Research*. 38, 313 – 320.

A.O.A.C, 2000. Official Methods of Analysis. Association of Official Analytical Chemistry, Washington D.C. 16th Edition.

Bainbridge, Z., Tomlins, K., Wellings, K., Westby, A. 1996. Methods for assessing quality characteristics of non -grain starch staple. Natural Resources Institute. Chatham, UK.

Henderson, S.M., Perry, R.L. 1979. Agricultural Process Engineering. VI Publishing company west port Connecticut. 2nd Edition, p255.

Ihekoronye, A.I., Ngoddy, P.O. 1985. Integrated Food Science and Technology for the Tropics. Macmillan, London. p386.

Ingram, J.S. 1975. Standards, specifications and quality parameters for processed cassava products. Tropical Products Institute Publication. No. G102, London.

Sanni, L.O., Ikuomola, D.P. 2001. Effect of length of fermentation and varieties on the quality of sweet potato gari. 8th Proceeding of ISTRC – AB Symposium, Ibadan, Nigeria. p208-212.

Laryea-Brown, S.A., Anderson, C.N. 1980. Processing of cassava tubers into gari, kokonte, fufu and tapioca – their utilization in Ghana. Food Research Institute Technical Report. No. 8. p56-61.

Oduro, I., Ellis, W.O., Dziedzoave, N.T. 2000. Quality of Gari from selected processing zones in Ghana. *Food Control*. 2: 297 – 303.

O'Hair, S.K. 1990. Tropical Root and Tuber Crops. p424-428.

Onwueme, I.C. 1982. The tropical tuber crops. 1st published by English language book society and John Wiley and Sons, Chichester, UK, p189-191.

Sullivan, J.N., Asher, C.J., Blamey, F.P.C. 1997. Nutrient disorders of sweet potato. Austriallian Centre for International Agricultural Research. Canberra. 9 -14.

Westby, A., Twiddy, D.R. 1992. Characterization of gari and fufu preparation procedure in Nigeria. *World Journal of Microbiology and Biotechnology*. 8: 175 – 182.

Woolfe, A.J. 1992. Sweet Potato; An untapped food resource. Cambridge University Press. 1st Edition. 280.

Table 1: Percentage Yield and Moisture Content of Sweet Potato – Gari

Samples	% Yield	Moisture Content (%, db)
Sweet potato-gari pretreated with 0.5% lime	40.1[a]	8.75[a]
Sweet potato-gari pretreated with 2.5% lime	40.0[a]	8.80[a]
Sweet potato-gari pretreated with 0.5% NaS2O5	40.0[a]	8.15[a]
Sweet potato-gari pretreated with 2.5% NaS2O5	40.1[a]	8.60[a]
Sweet potato-gari (no pretreatment)	40.0[a]	7.95[a]
Cassava-gari	42.0[a]	8.21[a]

In each of the columns, means of triplicate samples were recorded with different superscripts differ significantly ($P < 0.05$)

Table 2: Physicochemical properties of sweet potato –gari

Samples	pH	Total Titratable Acidity (%)	Swelling Capacity (%)	Particle size index
Sweet potato-gari pretreated with 0.5% lime	5.91[a]	0.96[a]	301[b]	35.76[a]
Sweet potato-gari pretreated with 2.5% lime	5.87[a]	0.99[a]	295[b]	35.20[a]
Sweet potato-gari pretreated with 0.5% NaS2O5	6.0[a]	0.94[a]	268[bc]	40.55[a]
Sweet potato-gari pretreat-ment with 2.5% NaS2O5	5.98[a]	0.98[a]	225[c]	38.20[a]
Sweet potato-gari (no pre-treatment)	5.86[a]	0.99[a]	295[b]	36.21[a]
Cassava-gari	4.42[b]	1.11[a]	430[a]	40.67[a]

In each of the columns, means of triplicate samples were recorded with different superscripts differ significantly ($P < 0.05$)

Table 3: Mean Sensory Qualities of Roasted Sweet Potato-Gari

Samples	Appearance	Mouth feel	Taste	Crispiness	Colour
Sweet potato-gari pretreated with 0.5% lime	5.50[b]	5.75[b]	6.10[b]	5.60[b]	5.40[b]
Sweet potato-gari pretreated with 2.5% lime	6.05[b]	6.25[b]	6.10[b]	6.75[a]	6.50[a]
Sweet potato-gari pretreated with 0.5% NaS2O5	5.80[b]	5.90[b]	6.10[b]	6.15[ab]	6.25[a]
Sweet potato-gari pretreat-ment with 2.5% NaS2O5	4.45[c]	5.3[bc]	5.20[c]	5.90[b]	4.00[c]
Sweet potato-gari (no pre-treatment)	2.75[d]	4.35[c]	4.45[c]	5.74[b]	2.90[d]
Cassava-gari	7.86[a]	7.84[a]	7.43[a]	7.65[a]	7.50[a]

In each of the columns, mean values with different superscripts differ significantly ($P<0.05$)

Table 4: Mean Sensory Qualities of Eba produced from Sweet Potato-Gari samples

Samples	Appearance (colour)	Aroma	Texture
Sweet potato-gari pretreated with 0.5% lime	5.80[b]	4.75[d]	5.10[c]
Sweet potato-gari pretreated with 2.5% lime	7.30[a]	7.05[a]	6.65[b]
Sweet potato-gari pretreated with 0.5% NaS2O5	7.60[a]	6.80[ab]	6.80[b]
Sweet potato-gari pretreatment with 2.5% NaS2O5	5.35[b]	5.40[c]	5.25[c]
Sweet potato-gari (no pretreatment)	3.10[c]	5.25[c]	4.50[d]
Cassava-gari	8.30[a]	7.83[a]	8.00[a]

In each of the columns, mean values with different superscripts differ significantly ($P < 0.05$)

Table 5: Mean Sensory Qualities of soaked samples of different Sweet Potato-Gari

Samples	Appearance	Taste	Soak-ability
Sweet potato-gari pretreated with 0.5% lime	6.05[b]	5.85[b]	6.25[b]
Sweet potato-gari pretreated with 2.5% lime	6.60[b]	6.35[b]	6.65[b]
Sweet potato-gari pretreated with 0.5% NaS2O5	7.30[a]	6.60[b]	7.15[a]
Sweet potato-gari pretreatment with 2.5% NaS2O5	4.20c	4.90c	4.60[d]
Sweet potato-gari (no pretreatment)	3.65[c]	5.15[c]	5.50[c]
Cassava-gari	8.00[a]	7.50[a]	8.10[a]

In each of the columns, mean values with different superscripts differ significantly ($P < 0.05$)