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Effect of Fermentation Time on the Physicochemical and Sensorial Properties of Gari from Sweet Potato (*Ipomoae batatas*)

Benoît Bargui Koubala[1*], Germain Kansci[2], Léa Bienvenu Enone Enone[1], Olivier Dabole Ngrong[1], Verlaï Yaya Ndjidda[1] and Marie-Ange Zang Essame[1]

[1]Department of Life and Earth Sciences Higher Teacher's Training College University of Maroua, P.O. Box: 55 Maroua, Cameroon.
[2]Department of Biochemistry, Faculty of Science University of Yaoundé I P.O. Box: 812 Yaoundé, Cameroon.

Authors' contributions

This work was carried out in collaboration between all authors. Author BBK designed the study, performed the statistical analysis and wrote the protocol. Author GK managed the analyses of the study. Authors LBEE, ODN, VYN and MAZE managed the literature searches and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: This study aims to investigate the sensorial and physicochemical suitability of sweet potato to be processed into gari.
Study Design: *TiB1* potatoes variety were grated and the obtained paste was left to ferment for 0, 1, 2, 3 or 4 days. Different fermented pastes were roasted at 90ºC with palm oil to obtain the various garis (G_0, G_1, G_2, G_3 and G_4).
Place and Duration of Study: This study was carried out in the Life and Earth Science Laboratory, at the University of Maroua, Cameroon between the periods of January to April 2013.
Methodology: The physicochemical characteristics, hydratation capacities and sensory properties of the different products were evaluated. The analysis were done by using a commercial cassava gari as reference.

**Corresponding author: E-mail: bkoubala@yahoo.fr;*

Results: Results showed that the fermentation time (p = 0.05) affects significantly the physicochemical properties and sensory attributes of the garis. Decrease of pH, ash content (19 to 11%), phenolic compounds content (8 to 5 mg / g), soluble sugars and starch content (17-13%) have been observed during fermentation. But in contract the titrable acidity (9 to 27 mg acetic acid / g), the bulk volume, the gel strength (12 to 24 g/100 mL) and protein content (10 to 14%) increased during fermentation process. Comparatively to potato gari, cassava gari exhibited a high titrable acidity (26 mg acetic acid / g), starch (23%) and protein content (15%) but low phenolic compounds (2.94 mg / g), free sugars content (1.01 mg / g) and the best hydration capacity. According to physicochemical analysis and organoleptic tests, the best potato gari is G_2 followed by G_1 and G_3. Color, mouth feel and acidity as well as food habit were found to be the determining attributes for panellists' preference.

Conclusion: From the present results, processing sweet potatoes into gariis one of a good way to reduce post-harvest losses.

Keywords: Sweet potato; fermentation time, gari, physicochemical properties, sensory attributes.

1. INTRODUCTION

Roots and tubers such as yam, cassava and sweet potato are foodstuffs which play an important role in food security, especially in Africa [1,2]. In terms of production, they are second after cereals. According to Scott et al. [3], more than two billion people in Asia, Africa and Latin America will depend on these crops for their nutrition and tax income by 2020. The sweet potato (*Ipomoea batatas*), native of South and Central America, was transported and introduced into China in the late 16th century [4]. Its roots are tubers which size, shape and colour vary depending on the variety and the environment where they are produced [5]. Globally, sweet potato is the seventh high carbohydrate staple after rice, wheat, Irish potato, maize, yam and cassava [6]. Its culture has been developed in developing countries where China is the main producer with 95% of world production [7]. Sweet potato is one of the most widespread root crops in sub-Saharan Africa [8]; Uganda being the principal African producer [9]. Several studies showed that sweet potato exhibit important amount of dietary fiber, minerals, vitamins and antioxidants [10,11,12].

Because of its extensive physicochemical characteristics, sweet potato has several uses: processing into flour, starch, alcohol production, cakes, cookies, lactic acid [10,13]. Despite this importance, sweet potato is facing the problem of post-harvest storage. In Cameroon and particularly in the far North region, conservation is essentially traditional (in pits) with a maximum duration of 4 to 6 weeks. On the other hand, sweet potato contains sugars such as raffinose, stachyose and verbascose which are indigestible sugars. The fermentation of theses sugars in the colon causes flatulence and abdominal chirp. Lin and Tsu [14] established that potato has a significant proportion of trypsin inhibitors which activity is affected by heat and storage conditions. In the Far North region of Cameroon food insecurity is severe with 4.1% of households [15]. For an early solution to these problems, processing of this tuber whose nutrients and vitamins intake is undeniable will be suitable. The obtained product will be available for a long time and contribute to diet. The objective of this work is to contribute to the valorisation of sweet potato by processing it in gari.

2. MATERIALS AND METHODS

2.1 Sampling

Previous investigations (Data obtained from Agriculture Research for Development Institute) of Maroua) revealed that sweet potatoes of *TiB1* variety were the most produced in the Far North region of Cameroon. These potatoes with white skin and yellow flesh were purchased in the markets of Maroua town (Cameroon) then transported to the laboratory where they were cleaned. About 30 tubers were weighed to determine the average mass of the potato. They were then peeled using a stainless steel knife. The resulting peels and flesh were also weighed to determine their mass ratio.

2.2 Processing of Potato in Gari

The potato gari (PG) were prepared using a modified method applied to gari cassava [16]. Using a grater the potato flesh was grated (3 mm mesh), to obtain a homogeneous paste. About 1 kg of potato paste was packed in a muslin stuff which was tied with sewing cotton. Under a heavy mass of 5 Kg, this was left to ferment for 0, 1, 2, 3 or 4 days. After fermentation, each fermented paste was crumbled through a sieve in order to uniform the particles size. Fermented potato paste was then roasted in a stainless steel pot by adding palm oil (5 mL / kg of paste). Using a wooden spoon the mixture was waggled every 30 seconds to prevent lumps formation. The different PG were obtained 15 minutes after cooking at 90℃. The gari was then weighed and pack ed in plastic bags and labelled (G_0, G_1, G_2, G_3 or G_4) according to the number of fermentation day.

2.3 Physicochemical Characterization of Sweet Potato and Its Gari

2.3.1 Dry matter content, pH, lipid content and ash content

Sweet potatoes flesh and the different processed gari were characterized compared to a commercial cassava gari (CG). The dry matter, pH, ash and lipid content of the samples were determined using standard AOAC methods [17]. Potatoes slurry (10% of dry matter content) was prepared before measuring the pH using a pH meter (HI 8424 Microcomputer Hanna instruments). Concerning the gari, it was soaked in distilled water (10 g / 100 mL) before filtration and the obtained filtrate was used to measure the pH of the gari.

2.3.2 Titrable acidity, starch, carbohydrates, free sugars and total phenolic compounds

The carbohydrates and free sugars (soluble in ethanol 80%) content of potatoes flesh and gari were assessed using Orcinol colorimetric method [18]. The starch content of the samples was determined by the iodine [I_2 0.2% in (KI 2 % in HCl 0.1N)] colorimetric method as performed by Jarvis and Walker [19]. According to AOAC method [17], titrable acidity of the gari was determined by titration with NaOH 0.01N. Results were expressed in terms of mg of acetic acid per g of sample. The total phenolic compounds were assessed using the Folin-Ciocalteu reagent [20] and the results were expressed as mg gallic acid equivalents per gramme sample.

2.3.3 Free amino acids and total protein content

Ninhydrin colorimetric method as described by Michel [21] was used for free amino acid content of gari and potato flesh. This was performed after water extraction. The total protein content of the samples was determined using the acetyl acetone and formaldehyde colorimetric method as described by Devani et al. [22]. This was performed after mineralization of the sample according to the Kjeldahl method [23]. The nitrogen content of the sample was also evaluated after the reaction of ammoniac (NH_3) with acetyl acetone and formaldehyde to form a yellow complex (3, 5-diacetyl-1, 4-dihydrolutidin). The protein content of the sample was determined using a conversion factor of 6.25.

2.3.4 Bulk density, water absorption capacity (WAC), gelling capacity and swelling kinetic

The bulk density of PG, was evaluated using a measuring cylinder as performed by Adeleke and Odedeji [24]. Results were expressed in terms of g of sample which corresponds to 100 mL after tapping. Concerning the swelling kinetic, 500 mg of dried gari was introduced in a measuring cylinder (100 mL) where it was mixed with 50 mL of distilled water. The gari was allowed to hydrate for 90 minutes at room temperature and its volume recorded every 2 or 5 minutes till equilibrium. A graph of unit millilitre per gramme of dried gari in function of time was plotted. For WAC, 250 mg of sample were introduced in a tube containing 10 mL of distilled water. The sample was soaked overnight (16 h at 4ºC). The slurry was put on a G_2 sintered glass to allow the water to leak. When no water leaking was observed for 1 hour, the sample was weighed, dried (100ºC) and weighed again. The WAC was expressed in terms of mL of water absorbed by one gramme of sample.

Results on potatoes flesh were expressed on fresh weight basis and those of gari on dry weight basis. The reagents were of analytical grade. All analyses were performed in triplicate.

2.4 Sensory Evaluation of Potatoes Gari (PG)

CG and PG were soaked in a 10% sucrose solution. The obtained slurries were then sensorial appreciated. Thirty panellists (men and women) were selected based on their ability to differentiate graded concentrations of sugar, citric acid and acetic acid solutions. They were then presented with different PG for the evaluation of their colour, smell, sweetness, acidity, mouth feel and preference using a 5-point hedonic scale [25].

2.5 Statistical Analysis

Results were given by the means ± standard deviation. They were compared using independent sample Student's *t*-test, and the differences between them were determined by variance analysis ($p = 0.05$). Concerning sensory evaluation, chi-square test was used to identify factors determining the preferences of the panellists for the various gari, and Duncan's multiple range test to determine the gari that was different from the others [26].

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of Sweet Potato Flesh

The average mass of sweet potato tuber (*TiB1* variety) is 398 g (Table 1). The flesh represents approximately 78% of the tuber mass, while the skins are 22%. Potato peels exhibits a proportion lower than those of cassava (33 %) [27]. Table 1 shows that potato flesh has an average dry matter content of 33.50 % which is within the range 20-35 % proposed by Lebot [28]. Sweet potato flesh of *TiB1* variety has an average pH of 6.90 which is very close to that of cassava [29]. The ash content of sweet potato flesh analysed in this work is 26.55 mg / g (fresh weight basis). This value is lower than that (26.80 mg / g) observed by Ruiz [30].

Table 1. Means weight and some physicochemical characteristic of sweet potato of *tib1* variety

Characteristics	Potato		
	Whole	**Peels**	**Edible part**
Mean Weight *	398.60±53.46	89.54±17.38	309.30±37.25
pH	ND	ND	6.90±0.03
Dry matter (%)	ND	ND	33.50±0.75
Ash (mg/g)	ND	ND	26.55±0.17
Proteins (%)	ND	ND	4.09±0.17
Free amino acids (µg/g)	ND	ND	0.60±0.01
Carbohydrates (%)	ND	ND	23.05±0.34
Free sugars (%)	ND	ND	1.58±0.03
Starch (%)	ND	ND	19.71±0.17

Values are mean from triplicate (or 30) measurements ± standard deviation.*
ND = not determined.

On the fresh weight basis, Table 1 also shows that sweet potato flesh has a total carbohydrate content of 23.05%, which is lower than that (25.74 %) rated by Abubakar et al. [31]. However Soares et al. (2002) presented a wide range of potato carbohydrates values which lies between 13.4% and 29.2 %. The free sugars content of sweet potato is about 1.58%. The proportion of starch is 19.71 %; it is the most representative polysaccharides of sweet potato. Compare to sweet potato, cassava flesh has more starch [29]. However there are some potato varieties which exhibit a starch content of 28 % [32]. The total protein content (4.09 %) of sweet potato flesh analysed in the present work is lower than that (12.21 %) observed by Abubakar et al. [31].

3.2 Effect of Fermentation Time on the Physicochemical Properties of Sweet Potato Gari

3.2.1 The gari yield

The gari yield has decreased significantly (p = 0.05) with the fermentation time. It decreases from 24.42 to 20.20 % (g of gari per 100 g of potato) respectively from day 0 to day 4 of fermentation (Table 1). Highest values of cassava gari (CG) yield (31.20%) have been obtained by Karim et al. [29]. This suggests that cassava flesh has more dry matter than that of potato. This difference could also be due to the fermentation time.

3.2.2 The ash, pH and titrable acidity of potato gari (PG)

Fig. 1 shows that the ash content of gari decreases with the days of fermentation (19.0 to 12.3 mg / g dry matter). CG which was used as reference exhibits significantly high ash content (20.9 mg/g). It is noticed in Table 2 that the pH of PG decreases (from 6.41 to 4.65) as a function of fermentation time. Similar results were obtained by Coulin et al. [33]. In the same way as the pH decrease, we observe the increasing level of titrable acidity (from 9.18 to 27.54 mg acetic acid / g).

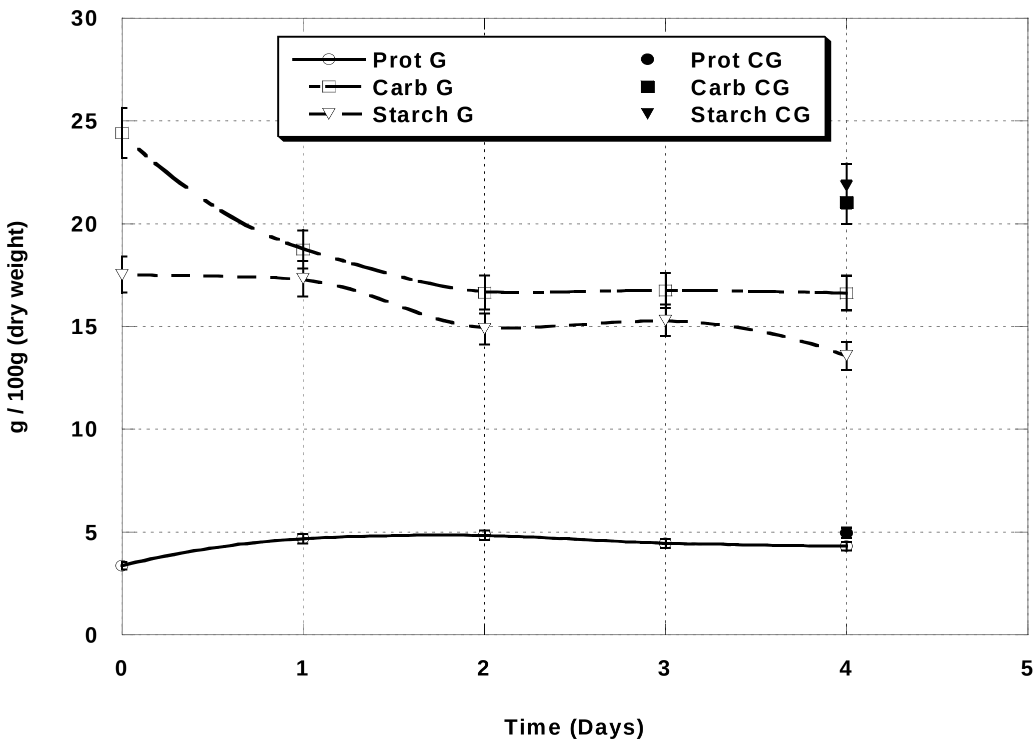

Fig. 1. Evolution of proteins (Prot), starch and carbohydrates (Carb) content of potato gari (G) in function of fermentation days. Potato gari (G) is compared with commercial cassava gari (CG)

Mean ± S.E.M = Mean values ± Standard error of means of three experiments
Values are given on the dry weight basis

3.2.3 The lipids, free amino acids, proteins and phenolic compounds content of potato gari (PG)

Phenolic compounds content is higher in sweet PG (4.74 to 8.01 mg / g) than in the CG (2.94). Despite this important value of phenolic compounds content of sweet PG, there is also a reduction of these compounds according to fermentation time (Table 2). Table 2 shows that the lipid content of PG varies from 11.86 to 19.00 mg / g. Fermentation time also influences the lipid content of gari. Compared to sweet PG, CG exhibits low lipid content

(10.22 mg/g). The free amino acids content is relatively low with sweet PG (2.61 to 3.21 µg / g) and CG (2.40 µg / g) (Table 3). Similar low value of amino acids content was also noted with other processed tubers as hardened tubers yam processed into flour [34]. After one day of fermentation, there is a significant (p = 0.05) level of free amino acids but when the fermentation day increase, this level of amino acids reduce. From 0 to second day of fermentation, the protein content of sweet PG rises from 35.8 to 48.4 mg / g. After two days of fermentation, a slight decrease is noted (Fig. 1). Irtwange and Achimba [35] also observed an increase in protein content of cassava gari (CG) from 23.3 to 25.5 mg / g but this was observed till the fifth day of fermentation. CG exhibits total protein content (49.7 mg / g) higher than that of PG. Overall, the protein content of gari increases with the time of fermentation. Similar results were noted by Delpeuch et al. [36] when studying starch digestibility of various food plants of South Cameroon. They showed that during the fermentation of some food plants, the protein content increases with the time.

3.2.4 The free sugars, carbohydrates and starch content of potato gari

Table 3 shows that the free sugars content of potato gari (PG) decreases (from 5.23 to 4.70 mg / g) with the fermentation time. CG contains only 1.01 mg / g of free sugars. On Fig. 1, it is noticed that the total carbohydrate content of gari decreases rapidly within the two first days of fermentation and stabilized within day three and four. However, the starch content does not rapidly decreases as the concentration of total carbohydrates. Values of total carbohydrates and starch content of CG are similar but they are higher than those obtained from PG. This similarity is due to the low free sugars content of cassava flesh.

3.2.5 The functional properties of sweet potatoes gari

The bulk density of potato gari (PG) varies from 47 to 67 g/100 mL (Table 3). The lowest value is noted with unfermented potato gari while PG obtained after two and four days of fermentation exhibit the highest bulk density similar to that of CG (67.43 g/100 mL). From zero to two days of fermentation, there is an increase in bulk density. At day three of fermentation, this value falls down before increasing at the fourth day of fermentation. Bulk density also depends on the particles size of gari with which it is inversely proportional [37].

The smallest gelling concentration (SGC) is the concentration at which the gel does not break under its weight. Table 3 shows that the increase of SGC is directly linked to the number of days of fermentation. The low concentration (12.5 g/100 mL) is attributed to PG which does not undergone fermentation while the highest was observed with gari obtained after 4 days of fermentation (24.25). Value obtained with unfermented gari are higher than that of sweet potato flour (3.68) analysed by Adeleke and Odedeji[24]. CG analysed in the present study also exhibits a SGC of about 20.5%.

As a function of fermentation days, the water absorption capacity (WAC) of PG varies sparsely (2.6 - 3.4 mL/g). There is no significant difference (p = 0.05) between the WAC of gari obtained after one, two and three days of fermentation (Table 3). In general, the WAC of CG (4.60 mL / g) is higher than that of PG (Table 3). This is due to the high starch content of CG (Fig. 1).

The swelling kinetics of PG has three phases (Fig. 2). A rapid swelling stadium observed at the first 10 minutes, followed by a deceleration phase and a stationary phase. Gari obtained after without fermentation (G_0) swells faster than others within the first 20 minutes followed by stabilization up to 90 minutes. This can be explained by its low density and small particles size that make it more easily accessible to water. G_1gari exhibits a better swelling kinetics than G_2, G_3 and G_4gari. Within the first 20 minutes, G_1 swells less than G_0 but after this time G1 swells more before stabilization at 60 minutes. Compared to PG, we notice that the swelling kinetics of CG has the best values over time.

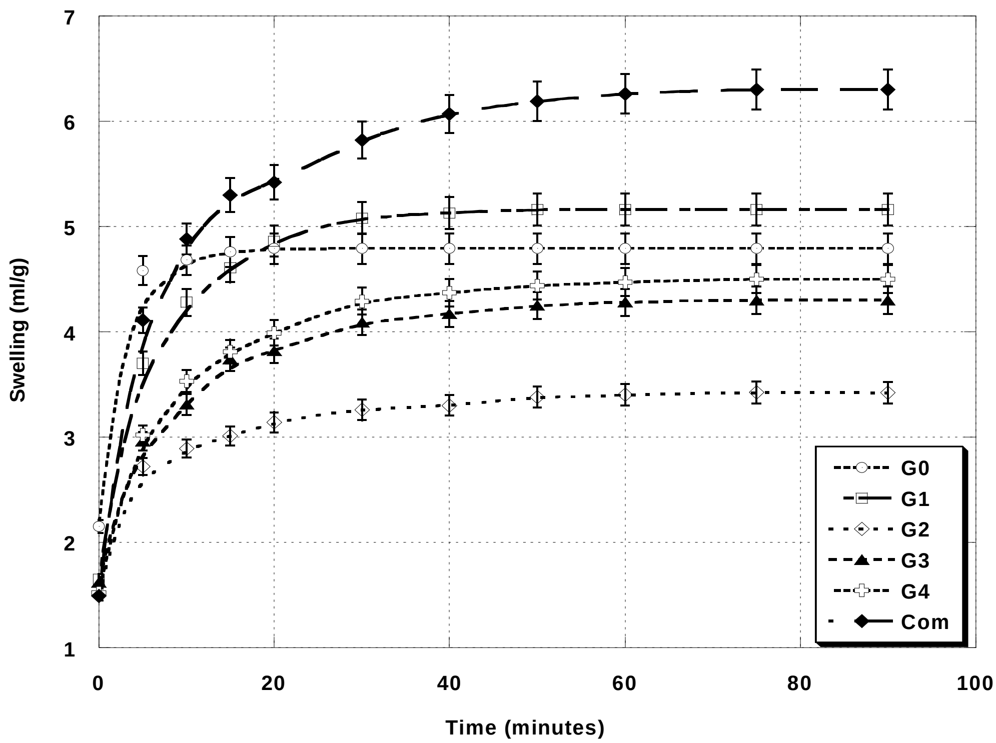

Fig. 2. Influence of the fermentation days (0, 1, 2, 3, and 4) on the swelling kinetic of potato gari. Potato gari (G) is compared with commercial cassava gari (Com)

Mean ± S.E.M = Mean values ± Standard error of means of three experiments

Values are given on the dry weight basis.

G_0, G_1, G_2, G_3 and G_4 are potato garis obtained after a respective fermentation day of 0, 1, 2, 3 and 4 days

3.3 Sensory Attributes of Sweet Potato Gari

3.3.1 Attributes of the soaked potato gari (PG)

To evaluate the sensorial properties of PG compared to CG, it was soaked in a sucrose solution (10%). Regarding colour, Table 4 shows that the soaked PG obtained without fermentation (G_0) has the highest score followed by G_2, G_1, G_3, and G_4. For the sweet taste, there is also a significant difference ($p = 0.05$) between the different garis. According to the panellists, G_0, G_1 and CG are the sweetest. According to the panellists, G_0, G_1 and CG are more acidic than G_2, G_3 and G_4. As the smell, the note assigned to different gari varies significantly ($p = 0.05$) according to the number of fermentation days. CG and G_0 and G_3 CG are the most popular panelists (Table 4). But the best score of mouthfeel is obtained with the cassava and G_2 CG.

Table 2. Effect of the fermentation time ash, phenolic compounds and lipids content, ph, titrable acidity and on the yield of potato gari. Potato gari is compared with commercial cassava gari

Fermentation time (days)	Characteristics					
	Yield (%)	Ash (mg/g)	pH	Titrable acidity (mg acetic acid/g)	Lipids (mg /g)	Phenolic compounds (mg/g)
0	24.42±0.56a	19.02±0.75ab	6.41±0.11a	9.18±1.53d	19.00±1.14a	8.01±0.44a
1	23.32±0.48b	18.00±1.02b	5.42±0.10c	15.30±2.16c	16.22±1.23b	5.34±0.33b
2	21.18±0.40c	13.87±0.56c	5.26±0.08d	22.95±2.33b	13.99±0.82c	5.68±0.19b
3	21.25±0.53c	11.28±0.63d	4.65±0.14e	26.78±2.24a	11.86±0.73d	4.74±0.14c
4	20.20±0.37d	12.29±0.87d	5.11±0.12d	27.54±2.16a	14.82±0.78c	5.60±0.19b
Cassava Gari	/	19.84±0.43a	5.69±0.08b	26.01±2.21a	10.22±0.58e	2.94±0.12d

Mean values from triplicate measurements ± standard deviation.
Values in the same column followed by different letters are significantly different (p=0.05).
Values are given on the dry weight basis with the exception of the yield (g of gari / 100 g of fresh potatoes)

Table 3. Effect of the fermentation time on the free sugars (FS) and free amino acids (FAA) content and on the bulk density, gelling and water absorption capacities (WAC) of potato gari. Potato gari is compared with commercial cassava gari

Fermentation time (days)	Characteristics				
	FS (mg/g)	FAA (µg / g)	Bulk density (g/100 ml)	Gelling capacity (g/100 ml)	WAC (ml / 10g)
0	5.23±0.10a	2.80±0.09bc	47.01±3.09c	12.50±1.50d	26.21±1.43d
1	5.00±0.23ab	3.21±0.10a	61.11±2.16b	16.00±1.00c	28.82±1.76c
2	4.84±0.26bc	2.91±0.04b	67.21±2.03a	20.75±1.50b	28.54±1.98c
3	4.71±0.11c	2.80±0.05c	62.07±2.12b	20.50±1.50b	29.73±1.32c
4	4.70±0.19c	2.61±0.10d	66.52±1.62a	24.25±1.00a	32.47±1.65b
Cassava Gari	1.01±0.08d	2.40±0.07e	67.43±1.73a	20.50±1.50b	46.82±2.12a

Mean values from triplicate measurements ± standard deviation.
Values in the same column followed by different letters are significantly different (p=0.05).
Values are given on the dry weight basis.

Table 4. Hedonic sensory mean scores for different potato gari (g_0, g_1, g_2, g_3 and g_4) compared to commercial cassava gari (Com). These gari were evaluated after soaking in a 10% sucrose solution

Attribute	Sample					
	G_0	G_1	G_2	G_3	G_4	Com
Color	3.37±0.43b	1.93±0.51d	2.60±0.50c	2.46±0.50c	2 .20±0.46cd	4.65±0.44a
Sweetness	3.80±0.51a	3.00±0.33ab	2.35±0.53c	3.10±0. 55b	2.96±0.45bc	3.48±0.45a
Acidity	3.40±0.25a	3.10±0.47a	1.83±0.25b	2.15±0.41b	1.96±0.39b	3.48±0.34a
Smell	3.07±0.45ab	2.48±0.32c	2.92±0.45b	3.10±0.41a	2.77±0.34bc	3.50±0.56a
Mouthfeel	2.80±0.47c	3.36±0.37bc	3.55±0.34ab	2.91±0 .46c	3.05±0.37c	3.97±0.47a
Preference	2.16±0.41e	3.12±0.55cd	3.86±0.45b	2.91±0 .55d	2.60±0.47d	4.75±0.44a

Values are means of scores awarded by panelists. Values in the same line with different letters are significantly different (p=0.05).
G_0, G_1, G_2, G_3 and G_4 are potato garis obtained after a respective fermentation day of 0, 1, 2, 3 and 4 days.

In terms of overall preference, CG was far more appreciated than all the PG. As for sweet PG, panellists prefer G_2 followed by G_1gari.

3.3.2 Correlation between sensory attributes and the preference of the panellists

To determine the effect of the sensory attributes (color, sweetness, acidity smell and mouthfeel) of PG on the scores for preferences of panelists, a chi-square test was used. For each gari, we found that preference of panelists positively associated with the color (+ 0.477), odor (+ 0.378) and sweetness (+ 0.333). According to the panelist, the acidity of the PG was loathsome. We noticed a negative association (- 0.324) between the preference and the acidity. Oluwamukomi and Adeyemi [38] also noticed that the acidity of gari semolina negatively influence the preference of the panelist.

4. DISCUSSION

The dry matter content of sweet potato flesh varies depending on the variety, the type of soil, the season and the production area [13]. If potato flesh has a sweet taste it is because of its high free sugars content compared to that of cassava. According to Lebot [28], this free sugars content can reach values of 5%. This allows using sweet potato juice in the manufacture of alcohol or lactic acid [10,13]. Cassava is more suitable for garification because of its high starch content.

The reduction of gari yield is linked to the degradation of potato components during fermentation including starch which is the main macromolecule. The amylolytic activity of microorganisms on potato paste converts some of the starch into free sugars which associated with the pre-existing sugars are catalysed into alcohol or organic acid. Soluble minerals from potato flesh are drained in the potato juice during paste pressing (under a heavy mass). If CG exhibit high ash content, this suggests that cassava flesh is richer in ash than that of potato. According to Karim et al. [29] the ash content of cassava flesh can reach 101 mg / g. Irtwange and Achimba [35] noted similar values of ash (16.5 to 24.6 mg / g) content of gari but these evolving as tooth saw and not in function of fermentation. The decrease of garis pH shows an acidification of tuber paste during fermentation [39]. The pH decrease and rapid increase of titrable acidity could be due to the accumulation of organic acids such as lactic acid and acetic acid resulting from the fermentation activity of microorganisms [33,40].

As for ash loss, the decrease of phenolic compounds could also be related to the water training of soluble compounds [41] and their degradation during fermentation. Knowing that potato flesh is very low in fat [5], lipids present here are mostly those added during gari processing. These differences could be explained by the esterification of lipids with organic acids synthesized during fermentation process. Fermentative microorganisms present in the potato paste may be using free amino acids to their macromolecules synthesis. This is one of the raison why it is noticed a reduction of free amino acid content during fermentation. But as free amino acid content reduced, that of proteins increase. This could be explained by the fact that during the fermentation process, microorganism multiplication induces a significant increase of biomass [42]. As for free amino acid, simple sugars found in sweet potato were used by fermentative bacteria which turn them into products such as ethanol, lactic acid and CO_2 [43]. Microorganisms used the free sugars available before attending the more complex starch.

The high density of commercial gari (CG) could be related to the particle size. As the smallest gelling concentration of gari increase, it could be due to the starch degradation during fermentation [34]. After the beginning there is a loss of the molecular organization of starch polymers [44]. This affect directly the water absorption capacity of the fermented gari. In fact the change of the starch structure as a result of dissolution and gelatinization are affected by the amylose/amylopectin and water/starch relationship [45, 46]. Moreover, the particle size [27] and the humidity [47] affect the absorption capacity. Delpeuch et al. [36] showed that sweet potato flesh contains more amylose than that of cassava. It was also reported that amylose acts both as a diluent and an inhibitor of swelling, especially in the presence of lipids with which it can form insoluble complexes during swelling and gelatinization [48]. This would justify the low values of water absorption capacity of potato gari (PG) compared to that of CG. As well as absorption capacity, the swelling kinetics is influenced by the composition, particles size [27], moisture [47] and fermentation time [35]. Aina et al. [46] found that starch from *Cardi* sweet potato cultivar which has 13% of amylose and 87 of amylopectin exhibit high swelling power and low viscosity compared to that from *Kizzy red* cultivar exhibiting 21% of amylose and 71 of amylopectin.

With gari obtained without any fermentation, the natural colour of the potato flesh is maintained and this can explained the fact that G_0 exhibit a good score of colour. However, the CG chosen as reference has significantly ($p = 0.05$) the highest grade of colour on a 5-point hedonic scale. Colour is one of the sensory attributes influencing the choice of panellists. As potato is sweet, the highest score obtained with G_0 and G_1gari could be due to the fact that at the beginning of fermentation, their free sugars are present and have not yet been used by fermentative bacteria. Since those panellists are accustomed to eating CG, it would have been difficult to objectively assess PG. But Meli et al. [49] noticed that sweet potato *dackere,* an African cereal/tuber food semolina was more appreciated than that from cassava by trained consumers.

5. CONCLUSION

This work was a processing trial of sweet potato into gari in order to overcome the problems of conservation and that of flatulence. Thus the *TiB1* sweet potato variety was transformed into gari after 0, 1, 2, 3 and 4 days of fermentation (G_0, G_1, G_2, G_3 and G_4). Processing yield and physicochemical properties of the different gari vary. The high reduction of free or indigestible sugars attributed to fermentative bacteria make sweet potato gari more digestible. On a 5-point hedonic scale, G_2 and G_1gari are the most appreciated by the panellists with a respective score of 3.86 and 3.12. But the commercial cassava gari used as a reference exhibits high score of 4.75. Contribute to food security returns to popularize these products. After all, quality control will be necessary.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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