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Protein Enhancement of Gari Using Soybean Flour Blend

Prince Owusu Amponsah
Department of biochemistry, PDM University, Bahadurgarh-124507, India
Corresponding Author: Prince Owusu Amponsah

----------*ABSTRACT*----------
Gari is widely consumed in Ghana, Nigeria, most countries of West Africa as well as in Brazil (Olagoke, et al., 2014).Due to its low cost, easy storage, long shelf life and ease of preparation, it serves as the major meal or dish among the low income earners. Consequently, the meal is often not balanced in diet depriving the poor of essential nutrients such as protein.
In the present investigation, sifted cassava mash and soybean flour were used in the preparation of nutritionally enhanced gari. The gari was prepared by mixing sifted cassava mash with soy flour in the ratios of 1:1, 3:2, 7:3, 4:3, 1:0 and roasted together for about 15 minutes each until if turned crispy. Complete Randomized Design (CRD) was used with five treatments including the control in three replications. The ratios constituted five (5) treatments encoded as T_1, T_2, T_3, T_4 and T_5. Each treatment was used to prepare four different foods. A sensory evaluation was undertaken by an in-house trained panel. The panelists were selected among students who eat gari a great deal. The results showed that all the treatments were liked. The most acceptability treatment was found to be T_4.
KEYWORDS: *Gari, Enhancement, Treatments Composition, Sensory Properties*

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I. INTRODUCTION

Gari is the most popular staple food derived from cassava and it is a creamy-white, granular flour with a slightly fermented flavour and a slightly sour taste made from fermented, gelatinized fresh cassava roots (Adegun, et al., 2011). It is the most developed and storable commodity from cassava and is widely consumed in Ghana, Nigeria, Brazil as well as in most countries of West African coast (Olagoke, et al., 2014).

It is a popular convenience food in West Africa due to its low cost, easy storage, long shelf life and ease of preparation and satisfying (Osseo-Asare, 2009). It is consumed either soaked in cold water or stirred in boiling water to make a stiff paste and consumed with choice soup and sometimes with dried coconut or fired groundnut (USAID / CORAF / SONGHAI, 2010). The major problem of consuming gari is the toxicity of cyanogenic glucosides from poorly processed cassava but greatly reduced during unit operation such as peeling, washing, grating, fermentation, dewatering and roasting (Oluwaseun, et al., 2014).

Cassava is very high in carbohydrate but low in protein and other nutrients, it is therefore believed that eating gari with little or no complementary sauce or stew for a very long period of time will lead to goiter and sometimes "kwashiorkor" in children (Abuye et al, 1998). And as such a poor diet can have injurious impact on health causing deficiency diseases such as scurvy (Mahan, and Escott-Stump, 2000).

Due to the financial constraints, people find it difficult buying any adequate protein source to add to their gari. The researcher finds it appropriate to enhance the nutritional value of gari blending it with soybean meal. This will make it possible for people to acquire adequate protein when they buy gari. The soybean (*Glycine max*) is one of the most important food plants of the world. It is a versatile food plant crop capable of reducing protein malnutrition (FRANKLIN, 1988). Soybean products are used in food industry in the world at large. The soybean seeds contain high quantity of protein and its amino acid composition is approximate to composition of animal proteins, therefore is often used as replacement component of meat protein (Hany A., 2011).

After the research, a more nutritious product of gari will be available for West Africa and beyond. By so doing this will minimize the cost of providing protein source to their gari. It will also create employment for individuals who cultivate soya beans and the processors of its products as well. It will help check malnutrition in West Africa and serve as a foundation for further research (Engelbert, et al., 2013). This is because the researcher identifies a lot of malnutrition problems and nutrient deficiency diseases among some West Africans, contributing to more than half of deaths in children worldwide; child malnutrition was associated with 54% of deaths in children in developing countries in 2001 (Engelbert, et al., 2013).So, after evaluating the nutritional properties and other genuine problems of malnutrition, sifted cassava mash and soybean flour was used for nutritionally enhanced gari production with the following objectives:

1. To determine the most suitable mix of cassava mash and soybean flour
2. To determine sensory characteristics of the enhanced gari

II. METHODS AND MATERIALS

Sample Collection/ Preparation

A total of 15 kg of freshly harvested cassava was acquired from the experimental farm of the Department of Agriculture Engineering and Mechanization of the University of Education, Winneba, College of Agriculture Education, Mampong-Ashanti. A bowl of soybean which weighs 7 kg was purchased from the local market of Mampong, Ashanti. Cassava and soybean were transported in clean poly sack and plastic bags respectively to traditional gari processing unit set-up by the Department of Agriculture Engineering and Mechanization. Cassava and soy bean were both stored at room temperature prior to preparation and fermentation.

Preparation of Mash and Flour

Cassava was peeled with a knife, washed with clean water and then grated using the "sasakawa" type of grater. The cassava mash was immediately put into a clean poly sack and left over-night to allow for partial fermentation and drainage of the excess liquid content. On the next day the bagged mash was put into a cassava mash press to further drain the excess liquid over a period of two days. The stones and other foreign materials were sorted out of the soybeans to improve its quality. The soybeans were roasted in an aluminum bowl for about 15 minutes. The burnt soybeans were removed to avoid the product tasting bitter. The soybeans were then sent for milling into flour. The different mixtures of the cassava mash and soybean flour was designed using Complete Randomized Design (CRD) which was made up of five treatments, including the control, in three replications as shown in table 1.

Table 1: Composition of different treatments

Treatment	Ration	Weight of cassava mash		Weight of soybean flour	
		kg	%	kg	%
T_1	1:1	1.5	50	1.5	50
T_2	3:2	1.8	60	1.2	40
T_3	7:3	2.1	70	0.9	30
T_4	4:1	2.4	80	0.4	20
T_5	1:0	3.0	100	0.0	00

Preparation of Gari mix

The treatment process as shown in figure 1, consist of cassava mash and soybean flour weighing 3kg per sample. It was sifted carefully using sieve to give a fine mixture; this was done in various proportions allocated to the treatments with one as a control. A gari roaster was put on fire to heat for about 5 minutes and cooking oil was applied to grease the roaster to prevent the gari from burning. The treatments were roaster for about 15 minutes and collected after each was found crispy.

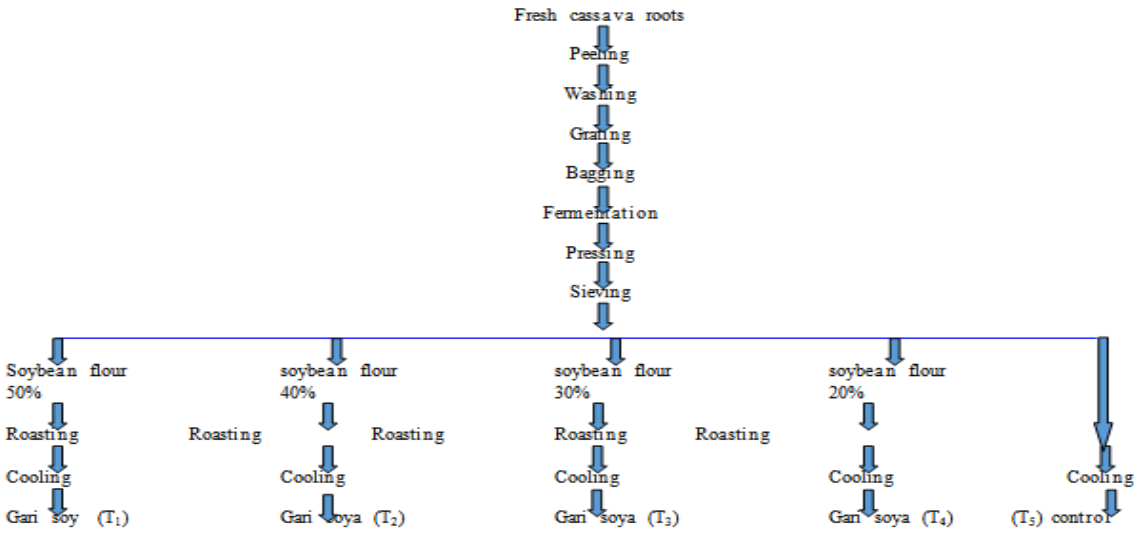

Figure 1: Process flow diagram of enhanced Gari Products

Data collection

The Department of Food and Hospitality of the University of Education, Winneba, College of Technology Education, Kumasi campus assisted in the preparation of the ballot sheets which were used to carry out a sensory analysis of each treatment. A hedonic scale was used to determine the degree of likeness (Peryam and Pilgrim, 1957).A purposeful approach was used to select ten (10) panelists who declared themselves regular consumers of gari/soy products, were asked to rate the samples on the basis of a 5-point hedonic scale anchored by: 1 = 'liked extremely'; 2 = 'like'; 3 = 'neither liked'; 4 = 'neither disliked'; 5 = 'disliked extremely' (GRANATO et al., 2012).

Product of each treatment was used to prepare three different foods of gari which were gari soaked in cold water "soakings", gari with sauce "shito", gari and beans stew for evaluation. The forth food was raw gari. The sensory analysis was carried out in four days, of which the panelist used a day each to assess the product to determine the preferred treatment for food.

In analyzing raw gari, the characteristics looked out for were; colour, aroma, taste, after taste, crispiness, smoothness and the overall acceptability. In the gari with sauce "shito", the colour, aroma, taste, after taste and overall acceptability of the product were taken into account. Again in the gari and beans stew the characteristics examined were colour, aroma, taste, after taste and overall acceptability. In the gari soaked in cold water "soakings" the properties looked out for were colour, aroma, taste, after taste and overall acceptability

Data analysis

The records obtained from the sensory analysis which was the raw data were analyzed by using Statistical Package of Social Sciences (SPSS). This resulted in the finding of the mean value of each meal to a particular treatment. The mean values for the various treatments used for different meals were found by taking the mean value of the parameters used for the meals under the different treatments divided by the number of parameters of a particular meal.

III. RESULTS & DISCUSSION

The Level of Likeness

When the treatments were eaten raw T_2, T_3 and T_4 were "Liked" more than T_1, which rated "Neither Like" with a mean value of 3.0 as shown in table 2. T_5 had the least rating in all the food items. This might be because it is the form of gari people are familiar with and it is without soya flour. For the gari with sauce "Shito", T_1, T_2 and T_3 were "Liked" but T_5 was considered "liked extremely". When the treatments were used to prepare gari soaked in cold water "soakings" T_4 was "Liked extremely" whereas T_1, T_2 and T_3 were "Liked". The rating of likeness for gari and beans stew T_1, T_2, T_3 and T_4 were all "liked" due to the mean value obtained by each treatment thus 2.3, 2.3, 2.6, 2.3 respectively.

Table 2: Rating of the treatments with food

	Rate of likeness				
Meals	T_1	T_2	T_3	T_4	T_5
Raw Gari	3.0	2.4	2.3	2.4	1.7
Gari with sauce "*Shito*"	2.2	2.2	2.1	1.9	1.7
Gari soaked in cold water "soakings"	2.3	2.8	2.5	1.9	1.9
Gari and beans stew	2.3	2.3	2.6	2.2	1.6
Total mean value of the treatments	2.5	2.4	2.4	1.9	1.7

The Most Acceptable Gari-Mix

The result from the sensory analysis shows that all the treatments were liked. Most of their ratings ranged from 1.6 to 2.5 (Table 3). Treatment four (T_4) with 80% of the sifted cassava mash and 20% of the soy bean flour was the most suitable mix. T_4 had an average value of 1.9 with the interpretation "like extremely". This treatment manifested to be liked in terms of colour, aroma, taste, after taste, crispness, smoothness and overall acceptability which made it to have a better average value over the other treatments.

In the main consumption areas, 80% of the population eats gari on the daily basis (Quenum, 2004). Since different people with different cultural background are going to have access to the product therefore the right mixture of sifted cassava mash and soybean flour should be produced. The product will help solve nutritional problems among the people in Africa. It was a poor man's crop but now elevated to an urban convenience food (Sanni, 2005). T_4 stands lofty when it comes to the preparations of food. Since there are different varieties of food made with gari the consumer should find the product to be more like the normal and to be able to use it in place of the normal gari without difficulties.

Preference Rating for Gari and Beans stew

Gari and beans stew was one of the foods used in the sensory evaluation of the treatments to assist in the determination of the most acceptable gari mix. The result was that T_1 to T_4 were not significantly different from each other at P≤0.05 (Table 3). But they were significantly different from T_5. This implies that in the food preparation of gari and beans stew T_3, T_4, T_1 and T_2 were all "Liked" and as such recommended for use based on their protein content.

Table 3: Preference Rating for Gari and beans stew

Treatments	Rating		
3	2.55	I	
4	2.45	I	
1	2.35	I	
2	1.95	I	I
5	1.50	I	

Preference Rating for Gari with sauce "*Shito*"

In Table 4, gari with sauce "shito" was analyzed based on the treatments. The results showed that T_1 to T_4 were not significantly different from each other at P≤0.05 (Table 4). T_1, T_3, T_4 and T_5 were also not significantly different but T_2 and T_5 were significantly different at P≤ 0.05 (Table 4.3). Whatever the level of significance all the treatments would be liked because their rating ranged from about 1.4 to 2.5 (Table 4).

Table 4: showing the Preference Rating for Gari with sauce "*Shito*"

Treatments	Rating		
2	2.50	I	
1	2.10	I	I
3	2.05	I	I
4	1.95	I	I
5	1.35		I

Preference Rating for Gari soaked in cold water "soakings"

The results showed that all the treatments were not significantly different from each other at P≤0.05 (Table 5). With the exception of T_4 with a rating of 2.6, the rest of the treatment would be liked because their rating ranged from 1.7 to 2.5.

Table 5: Preference Rating for Gari soaked in cold water "soakings"

Treatments	Rating	
4	2.60	I
5	2.45	I
1	2.15	I
3	2.00	I
2	1.70	I

Preference Rating for Raw Gari

The treatments were evaluated by the panel in raw state as raw gari and in addition analysis of variance was conducted. In table 4.5 the means showed that T_1, T_3, T_2 and T_4 were significantly equal and T_3, T_2, T_4 and T_5 were significantly equal but $T_1$and T_5 was significantly different from each other (Table 11). The means of T_3, T_2 and T_4 are rated "like" making them the preferred treatments when are used raw. The probability error of the analysis was given as 5%.

Table 6: Preference Rating for Raw Gari

Treatments	Rating		
1	3.05	I	
2	2.80	I	I
3	2.32	I	I
4	2.25	I	I
5	1.67		I

Preference rating for Overall Acceptability

Under the overall acceptability the mean values for the mean of each treatment with respect to the foods were found. In Table 7 an analysis of variance was conducted which resulted T_1, T_3, T_4 and T_2 been significantly equal, T_2 and T_5 were also significantly equal but T_1, T_3, and T_4 were significantly different form T_5 (Table 12). This shows that all the treatments are acceptable for use. On the other hand, using the products

will in turn provide protein for the body. The probability error of the analysis was given as 5% which makes the analysis reliable.

Table 7: Preference rating for Overall Acceptability

8’	Rating	
1	2.40	I
2	2.32	I
3	2.27	I
4	2.10	I I
5	1.70	I

Table 8: analysis of variance of gari and beans

Source of variation	d.f	s.s	m.s	v.r	F pr.
rep stratum	3	1.4400	0.4800	2.06	
rep. units stratum					
Tmt	4	3.0080	0.7520	3.22	0.052
Residual	12	2.8000	0.2333		
Total	19	7.2480			

Table 9: analysis of variance of gari with sauce “shito”

Source of variation	d.f	s.s	m.s	v.r	F pr.
rep stratum	3	1.5740	0.5247	1.56	
rep. units stratum					
Tmt	4	2.7480	0.6870	2.04	0.152
Residual	12	4.0360	0.3363		
Total	19	8.3580			

Table 10: analysis of variance of gari soaked in cold water "soakings”

Source of variation	d.f	s.s	m.s	v.r	F pr.
rep stratum	3	2.9520	0.9840	2.37	
rep. units stratum					
Tmt	4	2.0520	0.5130	1.23	0.348
Residual	12	4.9880	0.4157		
Total	19	9.9920			

Table 11: analysis of variance of raw gari

Source of variation	d.f	s.s	m.s	v.r	F pr.
rep stratum	3	0.1960	0.0653	0.12	
rep. units stratum					
Tmt	4	4.5370	1.1343	2.04	0.152
Residual	12	6.6590	0.554		
Total	19	11.3920			

Table 12: analysis of variance of overall acceptability

Source of variation	d.f	s.s	m.s	v.r	F pr.
rep stratum	3	0.2080	0.0693	0.60	
rep. units stratum					
Tmt	4	1.2530	0.3132	2.71	0.081
Residual	12	1.3870	0.1156		
Total	19	2.8480			

IV. CONCLUSION

Most people in the Sub-Saharan Africa eat gari as soakings and other food preparation without adding any protein source due to the financial problem they face. Malnutrition is globally the most important risk factor for illness and death, contributing to more than half of deaths in children worldwide. In order to elucidate this problem, this research was carried out to enhance the protein content of gari by soybean flour blend. The result from the sensory analysis showed that T_4 was the most suitable mix with a mean value of 1.9 which means it is "Like Extremely". This was followed by T_1 and T_2 with the mean value of 2.4 representing "Like". Statistical analysis was done to the significant differences of the treatments. The result was that T_1 to T_4 was not significantly different from each other at $P \leq 0.05$. This implies that when any of the treatments were used to prepare food it would be liked by people.

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