DonnishJournals 2042-3564

Donnish Journal of Food Science and Technology
Vol 1(1) pp. 001-005 June, 2015
http://www.donnishjournals.org/djfst

Original Research Article

Effect of Soybeans Treatment on Some Quality Parameters of Soy-Gari

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Accepted 20th April, 2015.

The proximate, physicochemical properties and mineral composition of gari fortified with soy-mash that was treated at different processing methods were studied. The soybeans were treated using the following processing methods: soaking, boiling and roasting and each after milling was introduced into the cassava mash after fermentation at the ratio 3:7 (30% soy-mash and 70% cassava mash). The samples were subjected to aforementioned tests, which show that supplementation increased the protein, fats, ash and pH values, while hydrogen cyanide (HCN) content, titratable acidity reduced significantly ($p < 0.05$). The iron, phosphorus and calcium contents of soy-gari ranged from 1.43 to 1.77 mg/kg, from 49.42 to 69.54 mg/100 g and from 2.42 to 3.05 mg/100 g, respectively, with soaked soy-gari having the highest in terms of calcium and iron but significantly low in phosphorus. The value of trypsin inhibitor is significantly ($p < 0.05$) lower in soy-gari of roasted method than soy-gari samples obtained from other methods. It was also observed that in terms of odour, roasted soy-gari was preferred but there was no significant difference for overall acceptability in all treated gari samples. In reconstituted gari ('eba'), both soy-gari prepared from soaking and roasting of soybeans were generally preferred.

Keywords: Chemical, Physico-chemical, Mineral, Sensory, Soy-gari.

INTRODUCTION

Gari is a fermented, dewatered and roasted product from cassava (*Manihot esculenta*), widely consumed all over West Africa and in Brazil (Kordylas, 1990). It is the most important item in the diet of millions of Nigerians (IITA, 1990). Traditionally, it is produced by pressing the juice out of peeled, grated cassava roots, allowing a natural fermentation process to take place for 2 – 5 days. The fermented mash is then roasted in an open aluminum pan over an open fire until the starch granules gelatinizes to 65 % of its native form and moisture content falls to less than 12 % dry basis (Chuzel and Zakhia, 1986).

It is commonly consumed either by being soaked in cold water with sugar, to be eaten with coconut, roasted groundnut, dry fish or boiled cowpea or by reconstituting with boiled water to make dough to be eaten with any soup. When properly stored, 'gari' has a shelf life of six months or more (Osho, 2003). More attention has drawn to the low nutritional composition of gari such as phosphorus, calcium, iron, methionine, lysine, tryptophan, phenylalanine, tyrosine e.t.c. The choice of soybean is not far-fetched from the fact that it contains total protein and phytoestrogens which have been found out to counter the activities of cardiovascular diseases, heart attack, symptom in menopausal women, brain and nerve function. It also fights some cancers with some minerals that take care of some of the challenges facing the human race from diseases and defects from over-consumption and reliance on carbohydrate and starch present in gari (Lin *et al.,* 2004). Result of previous studies of fortification of cassava product using soybean has shown that fortification improves nutritional quality of resulting meals (Oshodi, 1985; Osho, 2003; Oluwamukomi *et al.,* 2005).

However, it is not enough to supplement the product alone, but there is a need for proper study of its behaviour under certain thermal and physical treatment (i.e. boiling, roasting, and soaking) so as to understand the physicochemical change in the products.

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MATERIALS AND METHODS

Materials

Cassava (*Manihot esculenta*) roots were obtained from Teaching and Research Farm of Ladoke Akintola University of Technology Ogbomoso, Oyo State Lagos. Soybean (*Glycine max*) was purchased from Oja-Igbo market in Ogbomoso, Oyo State, Nigeria.

Sample preparation

Soybeans were cleaned, divided into three (3) parts and treated with the different processing methods (soaking, boiling and roasting) of preparation. These were milled and introduced into the cassava mash after fermentation stage using 30% of the supplement level. A control sample was also produced without supplementation. The soy-gari was produced by modifying the method of Oluwamukomi and Jolayemi (2012) as shown in Figure 1.

Analysis of the samples

The proximate compositions were determined according to the standard of AOAC (2005), carbohydrates were obtained by difference. Mineral composition such as phosphorus, iron and calcium were also determined by method of AOAC (2005).
Physicochemical properties (swelling power, solubility and HCN content) were determined by AOAC (2005), Trypsin inhibitor was determined by method of Kricka *et al*. (2009), pH and TTA were determined by the method of Pearson (1995) and sensory evaluation was determined by using nine point hedonic scale ranging from 9 = like extremely to 1= dislike extremely was used by the trained panelists for the following attributes: taste, odour, appearance, texture and overall acceptability.

RESULTS AND DISCUSSION

Chemical composition

The results of proximate composition obtained on gari fortified with soy-mash of different methods of preparation are as shown in Table 1. Moisture content of the sample ranged between 0.54 and 6.96 % with the control sample having the lowest value and the soy-gari made from soaked soybeans, the highest. Significant difference ($p < 0.05$) exists among all the samples. It was observed that all the samples supplemented with soy-mash are drastically higher than the control. Oluwamukomi *et al*. (2007) gave a similar range (2.07 – 7.02 %) in gari semolina fortified with full fat soy-melon blends. All these were within the specified range of gari as given by Chuzel and Zakhia (1986).

Ash content of the samples ranged from 1.29 to 1.46 % with the control sample having the lowest value and soy-gari made from roasted soybeans, the highest. This was due to the fact that soybeans are rich in minerals. The values obtained were comparable to the range (1.15 – 2.25 %) obtained by Oluwamukomi *et al.* (2007). The fat content of the samples ranged from 1.29 (in control) to 5.20 % (in boiling method). It was observed that the fat content increases tremendously due to high fat content (20 %) of soybean. Oluwamukomi *et al.* (2007) also made similar observation whose values ranged between 3.20 and 15.80 % of soy-melon gari. Protein content of soy-gari ranged between 1.68 and 10.90 % with the control sample having the lowest value and soy-gari made from boiled soybean, the highest. Significant difference ($p < 0.05$) exists among all the samples. The low value of protein in control is due to the minute quantity of protein present in cassava as reported by Ihekoronye and Ngoddy (1985). Though the values obtained in the supplemented samples increased to some extent that, it gives one third of the daily requirement of protein as given by WHO (2007).

Crude fibre content of sample ranged from 2.00 % in boiled soy-gari to 2.16 % in soaked soy-gari. There was no significant difference ($p < 0.05$) in roasted soy-gari and control. The values obtained fall within the range obtained by Oluwamukomi *et al.* (2007) who reported 2.40 – 6.80 % in soy-melon gari. Carbohydrates content of the samples ranged from 73.59 to 92.95 % with the soy-gari made from soaked soybeans having the lowest value and control due to lack of protein supplement, the highest. Significant differences ($p < 0.05$) exist in the entire sample.

The mineral content of the samples are as shown in Table1.The calcium level of soy-gari ranged between 2.42 mg/100 g (roasted soy-gari) and 3.05 mg/100 g (soaked soy-gari). No significant difference ($p < 0.05$) exists in soaked soy-gari, boiled soy-gari and control sample. Iron content which is the major component of hemoglobin that helps in transporting oxygen to all parts of the body ranged from 1.43 to 1.77 mg/kg. The roasted soy-gari sample had the lowest value and soaked soy-gari, the highest. The iron content values were significantly ($p < 0.05$) differ among the samples. Phosphorus content of the sample ranged from 49.62 mg/100 g (soaked soy-gari) and 69.54 mg/100 g (boiled soy-gari). No significant difference ($p < 0.05$) exists among roasted soy-gari and control samples. Oluwamukomi et al. (2007) made similar range (16.25 – 49.41 mg/100 g) on soy-melon gari.

Physico-chemical properties

The result of physico-chemical analysis of soy-gari is shown in Table 2. The swelling capacity of a food material is the measure of ability of flour/starch to imbibe water and swell. The result of swelling capacity obtained ranged from 1.10 % (soaked soy-gari) and 1.14 % (boiled soy-gari). Significant difference ($p < 0.05$) exists in the entire samples. There was a reduction in the starch component in the enriched samples which could have reduced the absorption of water. In a related study by Prinyawiwatkul *et al.* (1994), the reduced swelling capacity was attributed to high fat content which might have reduced the ability of a mixture of wheat and peanut flour to bind water. Cheftel *et al.* (1985) also attributed to this phenomenon to the presence of lipids in the soy-melon supplement which must have reduced the swelling capacity of the gari granules. However, the sample enriched with boiled soybeans produced soy-gari of higher swelling and water holding capacities.

Hydrogen cyanide is a colourless, extremely poisonous liquid that boils slightly above the room temperature at 25.6 ^oC (Gail and Sauer 2005). Heat effect could reduce HCN because heat destroys cyanide in cassava (Irtwange and Achimba, 2009). The cyanide content of the samples ranged from 0.41 mg/100 g (soaking method) to 0.59 mg/100 g (control). ANOVA shows that there was significant ($p < 0.05$) different among the samples. The result shows that control sample has the highest cyanide content due to the diluting effect of soybean supplements (Sanni and Sobaniwa, 1994).

The result obtained in the analysis shows that pH ranged from 4.75 to 5.10. No significant difference ($p < 0.05$) exists among the samples obtained from soaking, boiling and roasting methods of soybeans.

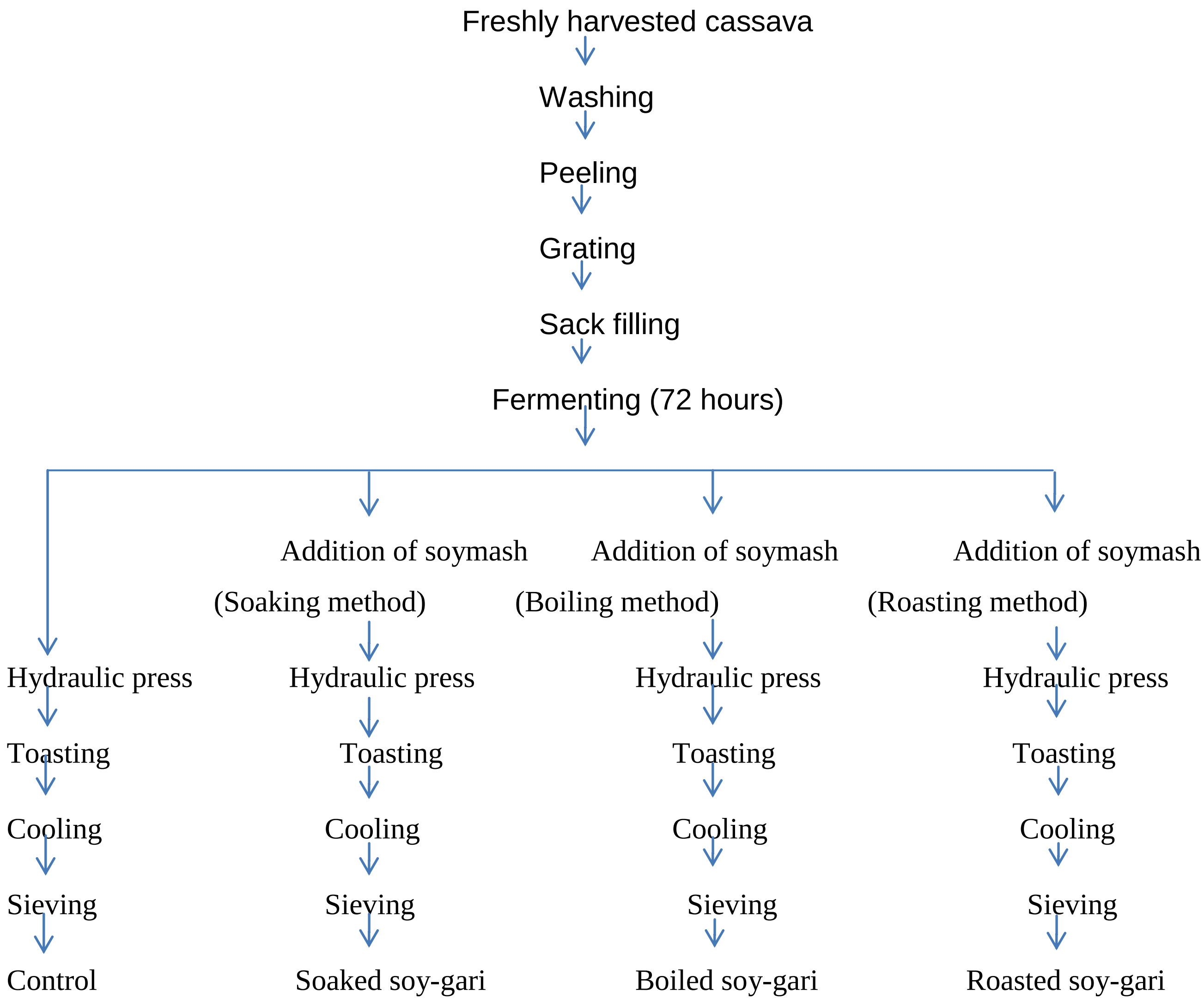

Fig. 1: Flowchart for processing techniques for soy-gari samples

Table 1: Chemical composition of soygari

Property	Soaked soy-gari	Boiled soy-gari	Roasted soy-gari	Control
Moisture (%)	6.96a	5.17b	2.46c	0.54d
Ash (%)	1.33c	1.42b	1.46a	1.29d
Fat (%)	5.15b	5.20a	4.74c	1.29d
Protein (%)	10.85ab	10.90a	10.77b	1.68c
Crude fibre (%)	2.16a	2.00c	2.08b	2.09b
CHO (%)	73.59d	75.32c	78.68b	92.95a
Ca (mg/100 g)	3.05a	2.99a	2.42b	2.97a
Fe (mg/kg)	1.77a	1.43d	1.45c	1.56b
P (mg/100 g)	49.62c	69.54a	64.22b	64.42b

Mean along the row with the different alphabet(s) are significantly different ($p < 0.05$)

Table 2: Physico-chemical properties of soygari

Property	soaked soy-gari	boiled soy-gari	roasted soy-gari	control
Swelling index (v/v)	1.102d	1.144a	1.107c	1.119b
Solubility	2.490b	2.450b	2.195b	2.735a
TTA %	0.155c	0.125c	0.410a	0.335b
HCN (mg/100 g)	0.410d	0.535b	0.465c	0.590a
pH	5.100a	5.050a	5.000a	4.750b
Trypsin inhibitor (mg/100 g)	1.350a	0.750b	0.250c	0.000d

Mean along the row with the different alphabet(s) are significantly different ($p < 0.05$).

Table 3: Sensory attributes of soy-gari in water

Sample	Taste	Odour	Appearance	Texture	Overall acceptability
Soaked soy-gari	6.75a	5.06ab	5.81a	6.37a	6.75a
Boiled soy-gari	6.57a	4.68ab	5.06a	5.81a	6.81a
Roasted soy-gari	5.81	6.57a	5.89a	6.01a	6.75a
Control	4.50b	3.78b	3.56b	4.68b	4.50b

Mean along the column with the different alphabet(s) are significantly different ($p < 0.05$).

Table 4: Sensory attributes of reconstituted soy-gari ('eba') samples

Sample	Taste	Odour	Appearance	Texture	Overall acceptability
Soaked soy-gari	6.75a	6.19a	6.75a	7.49a	6.57a
Boiled soy-gari	5.06ab	4.50ab	4.50ab	4.32b	4.88b
Roasted soy-gari	5.45ab	6.19a	6.57a	5.45ab	6.75a
Control	4.32b	4.12b	3.38b	3.78b	4.68b

Mean along the column with the different alphabet(s) are significantly different ($p < 0.05$).

This shows that supplementation with soy-mash tends to make the gari less acidic by the dilution effect of the supplements on the sourness of gari samples. The values obtained were comparable to the range (3.58 – 4.94) obtained by Oluwamukomi *et al.* (2007) in gari semolina fortified with full fat soy-melon blends. The titratable acidity of the samples ranged from 0.215 % (boiled soy-gari) to 0.410 % (roasted soy-gari). There was no significant difference ($p < 0.05$) between the samples obtained from soaking and boiling methods.

Trypsin inhibitor of the samples ranged between 0.00 and 1.350 mg/100 g with control sample having the lowest due to absence of soybeans and sample with soy-gari made from soaked soybean having the highest. Significant difference was observed among the samples which are as a result of different methods of preparation of soy-mash. Trypsin inhibitor was high in soaking method because heating reduces trypsin inhibitor more than soaking which reduces flatulence (Kolapo and Sanni, 2005).

Sensory Evaluation

The results obtained from sensory evaluation of soy-gari and reconstituted soy-gari ('eba') are as shown in Tables 3 and 4. For soy-gari, there was no significant difference ($p < 0.05$) among the treated samples in terms of taste, appearance, texture and overall acceptability while, in terms of odour, roasted soy-gari is more preferred than other samples. For reconstituted soy-gari, the result obtained shows that there was no significant difference ($p < 0.05$) between the samples obtained from boiling and roasting methods in terms of taste, in terms of odour and appearance, no significant difference ($p < 0.05$) was observed between the products obtained from soaking and roasting methods. There was no significant ($p < 0.05$) different in terms of texture between boiled soy-gari and control but soaked soy-gari is more preferred. Generally, the roasted soy-gari is more preferred for both soy-gari and reconstituted one ('eba').

CONCLUSION

From the result, it could be concluded that supplements improve the nutrient quality of gari. It also reduced the hydrocyanic acid content, thereby producing gari of higher quality and better safety. The acidity of the supplement sample was reduced, thus lowering the sourness of gari. This may be an advantage for people who are not interested in the sourness of gari. However, supplementation reduces the swelling index of gari. Supplementation using boiled soybeans soy-mash was found to be the best in term of chemical and physical properties while roasted soy-gari was preferred in terms of sensory attributes.

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