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Physico-Chemical Properties and Storage Stability of Soy-Gari Produced from Fabricated Soy-Gari Mixer

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Abstract

Soy-flour (20%) was incorporated into cassava mash (80%), mixed and garified. The prepared soy-gari was stored and analyzed monthly for six months. The results for both 100% gari (control) and soy-gari samples as storage time increased showed that, water absorption capacity decreased slightly; least gelation concentration had no noticeable change; bulk density increased; pH and free fatty acid increased; total titratable acidity decreased; moisture contents increased and a decrease was observed in viscosity. A significant difference ($P < 0.05$) was noted only in the taste of 100% gari while this was noted in the taste, texture and general acceptability of the soy-gari samples. Though there was no significant difference in the colour of the soy-gari for the six months. Despite the changes, all the samples were still acceptable after six months.

Key words: Cassava, Gari, Soy-gari, Sensory Evaluation, physico-chemical analysis.

Introduction

Food products are perishable by nature. Upon storage for a certain period, one or more qualities attributes of a food product may reach an undesirable state. Shelf life

is taken as the time within which a product remains stable and this depends on the processing method, packaging and storage of the food product. Considerable effort has been made in predicting and monitoring shelf life in recent years. Methods of prediction are particularly relevant for new products which do not have a history of distribution. The predictions are based on the mechanisms of deterioration and the rate at which they occur. In the search for cheaper but nutritious food, soybeans have been utilized in composite with gari.

Gari (roasted cassava mash) the most commonly used form of cassava in West Africa, account for some 70% of the entire cassava production in Nigeria (FAO, 2004). It is a free flowing particulate product consisting of cassava particles which have been gelatinized and dried. It offers little or no nutrition apart from carbohydrate unlike soybean which has high quality protein of 43% and can be compared to the level of 49% protein in meat, Anazonwu (1985).

However, incorporation of 20% soybeans flour into gari in order to enhance its protein content and to produce a composite product called soy-gari is becoming increasingly popular (Oni, Alakali & Akpapunam, 2008). Many works have been done on the quality of soy-gari. Soy-gari is processed differently in different parts of Nigeria for the preparation of a moulded food popularly known as "*Tuwo gari*" amongst the Hausa and "*Eba*" amongst the Yoruba and Ibos.

The major challenges often encountered in the storage of most dehydrated food products are those of insect's infestation and mould infestation. This could be as a result of storage conditions, hygroscopic nature of dehydrated foods and the use of poor packaging materials. For foods stored in form of flour, the most common form of spoilage arises from oxidation of fats, giving rise to rancidity (Onwuka, 2005). Soy-gari for instance, can be susceptible to infestations during storage by weevils, which are prolific, breed rapidly and cause serious deterioration in the nutritive value of the food. However, there is paucity of documented information on the storage stability of soy-gari.

Objective of the Study

The major objective of this study was to investigate the physico-chemical properties of soy-gari during storage. Specifically, the study determined:

1. shelf-life of soy-gari.
2. effect of storage period on the physico-chemical properties of soy-gari.

Materials and Methods

Plan of the Study: The study was carried out through the following procedures:

A. Sample Preparation:

i. Good quality Cassava (*Manihot esculata*) roots and soybean (*Glycine max L.*) seeds were bought at the North bank market, Makurdi, Benue State and processed as shown in Fig. 1.

ii. Cassava was prepared by the method described by Asiedu (1989). The roots were peeled manually with stainless steel knife. The peeled roots were washed and grated. The grated pulp was put into a cloth bag and fermented for four (4) days. The fermenting pulp was dewatered by heaping heavy stones that were securely fastened on the bag to express water or juice from the mash. The dewatered mash was then removed from the bag and sieve into particle size 1.70mm. iii. Soybean flour was prepared by the method described by Asiedu (1989). The soybean was cleaned to remove contaminants and stones. It was washed, partially boiled (for about one hour in autoclave), dehulled and dried in the oven at 60^0C before milling.

B. Mixing Formulation:

i. 20% soy-flour was incorporated into cassava mash (80%) as described by Oni, Alakali and Akpapunam, (2009).

ii. The particle size analyses for cassava mash was done as outlined in ASAE Standard 319 using a British Standard sieve (1.70mm aperture) and pan. The Endicott type mechanical sieve shaker was used throughout. The soy-flour and the cassava mash were thoroughly mixed for 10 minutes in the fabricated mixer. The sample was garified, cooled and packed in a straw bag and stored at room temperature (30 ± 2^0C) for six (6) months.

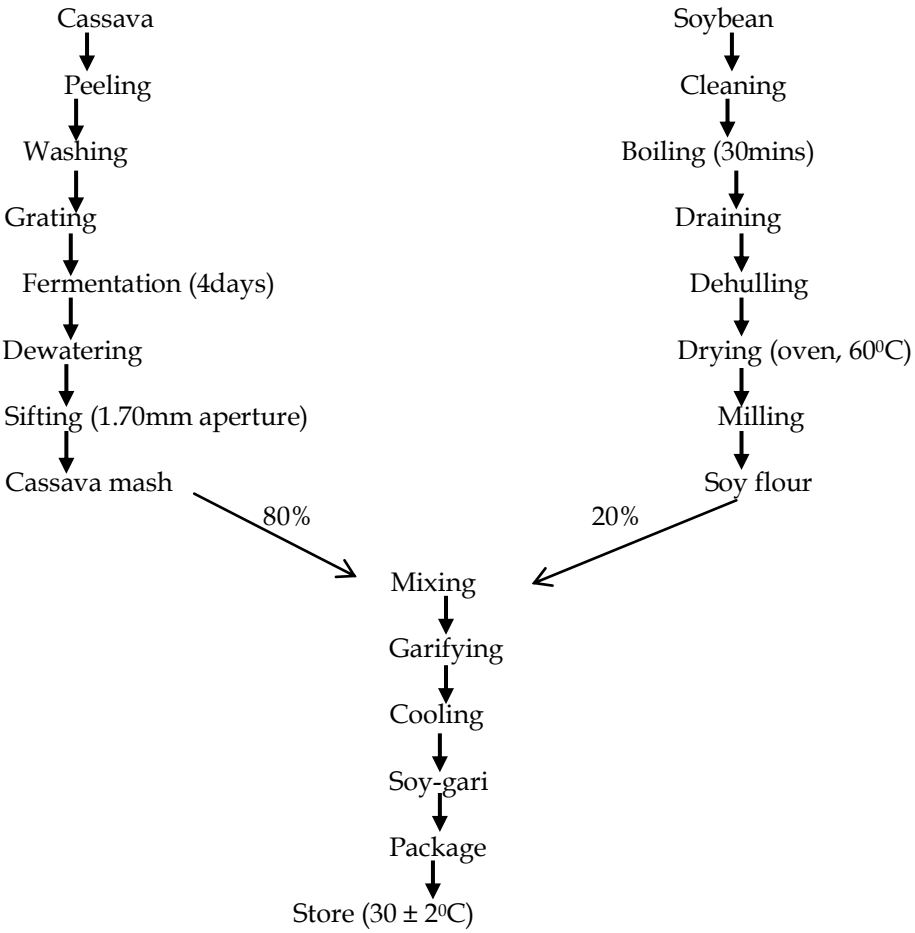

Fig. 1: Preparation of soy-gari from mixtures of cassava mash and soy flour.
Source: Oni *et al.,* (2009).

Physico-chemical Analysis

The following physico-chemical properties of the samples were carried out for fresh sample and during the 1st, 2nd, 3rd, 4th, 5th, and 6th months of the studies:

i. *Water Absorption Capacity*: This is the quantity of water required to mix dough to a standard consistency. It was determined as described by Onwuka (2004).

ii *Least Gelation Capacity*: This was determined as described by Sathe, *et al,* (1985).

iii *Bulk Density*: This is the density of the bulk material as a result of tapping solids materials poured into a container. It was carried out as reported by Onwuka (2004).

iv *Viscosity*: This is the internal friction of a fluid or its tendencies to resist flow. It was determined using the method of Onwuka (2004).

v. *pH:* This measures the degree of acidity and alkalinity of food materials. It was determined as described by Onwuka (2004).

vi. *Moisture Content*: This is a major part of the food and its absorbed moisture plays an important role in the growth of moulds and fungi that cause spoilage in food. It was determined by the forced oven air dry method of the Association of Official Analytical Chemist (AOAC, 2006).

vii *Free Fatty Acid Content*: This was determined by the forced oven air dry method of the (AOAC, 2006).

viii. *Total Titratable Acidity*: This is used to determine the maturity of some fruits and vegetables and also the spoilage of food products. This was determined by the forced oven air dry method of the (AOAC, 2006).

Sensory Evaluation:

1. ***Instrument for Data Collection*:** The samples were coded and validated questionnaire made up of quality evaluation for flavor, texture, colour and general acceptability was used. Quality ratings were based on a 5-point descriptive hedonic scale with 5 (like extremely) being the highest score and 1(dislike very much) the least score (Ihekoronye and Ngoddy, 1985).
2. ***Panel of Judges*:** The population was made up of ten (10) students of Food Science and Technology, University of Mkar, Mkar, Benue State. The purposive sampling technique was adopted in the selection of the panel of judges because the students have better knowledge of food than other students and would therefore give better interpretation on what would be required on them.
3. **Samples Evaluation Period:** The sensory evaluation was repeated every month for six months of the studies to determine the effect of storage on the sensory properties of the samples.

Statistical Analysis.
Means were compared using test of significant difference (Steel and Torrie, 1980). Test of significant ($P<0.05$) difference among the treatments were determined by Analysis of Variance (ANOVA) as described by Steel, R.G.D., Torrie, J.H. and Diekey, D.A. (1997).

(1) Effect of storage on physico-chemical properties of gari. See Table 1.
(2) Effect of storage on physico-chemical properties of soy-gari. See Table 2.
(3) Mean sensory scores of gari. See Table 3.
(4) Mean sensory scores of soy-gari. See Table 4.

Results
The following findings were made:
Table 1: Effect of Storage on Physico-Chemical Properties of Gari.

No of month	WAC (g/g)	LGC (w/v)	BD (g/cm^3)	pH	FFA (%)	TTA	MC	V (rpm)x
0	4.80	0.60	0.62	4.23	0.14	0.09	7.20	37.10
1	4.70	0.60	0.63	4.26	0.20	0.08	7.90	35.30
2	4.50	0.60	0.65	4.29	0.29	0.06	8.40	31.00
3	4.30	0.60	0.65	4.33	0.32	0.05	9.70	29.20
4	4.00	0.60	0.66	4.37	0.39	0.04	10.40	26.50
5	3.80	0.60	0.68	4.41	0.42	0.03	10.90	24.40
6	3.70	0.60	0.69	4.44	0.54	0.02	11.40	20.20

Key: WAC- Water Absorption Capacity; LGC- Least Gelation Capacity; BD-Bulk Density; FFA-Free Fatty Acid; TTA-Total Titratable Acidity; MC-Moisture Content; V-Viscosity

Table1 shows some physico-chemical properties of 100% gari. As storage time increased WAC, TTA and V decreased while BD, pH, FFA and MC increased. But LGC had no noticeable change.

Table 2: Effect of Storage on Physico-Chemical Properties of Soy-gari.

No of month	WAC (g/g)	LGC (w/v)	BD (g/cm^3)	pH	FFA	TTA (%)	MC	V (rpm)x
0	4.90	1.00	0.61	5.02	0.23	0.11	8.80	34.60
1	4.80	1.00	0.62	5.03	0.28	0.09	9.90	34.30
2	4.60	1.00	0.63	5.06	0.46	0.07	10.40	27.80
3	4.40	1.00	0.64	5.08	0.53	0.05	11.20	23.50
4	4.30	1.00	0.65	5.12	0.59	0.03	12.40	18.30
5	4.20	1.00	0.66	5.16	0.62	0.02	13.60	13.40
6	4.10	1.00	0.67	5.20	0.76	0.01	14.80	10.80

Key: WAC- Water Absorption Capacity; LGC- Least Gelation Capacity; BD-Bulk Density; FFA-Free Fatty Acid; TTA-Total Titratable Acidity; MC-Moisture Content; V-Viscosity

Table 2 shows some physico-chemical properties of soy-gari. As storage time increased WAC, TTA and V decreased while BD, pH, FFA and MC increased. But LGC had no noticeable change.

Table 3: Mean Sensory Scores of the Gari.

No of month	Colour	Flavour	Texture	General Acceptability
0	4.8 [a]	4.6 [a]	4.6 [a]	4.9 [a]
1	4.8 [a]	4.5 [a]	4.6 [a]	4.9 [a]
2	4.7 [a]	4.5 [a]	4.5 [a]	4.8 [a]
3	4.6 [a]	4.4 [a]	4.4 [a]	4.6 [a]
4	4.5 [a]	4.2 [a]	4.2 [a]	4.6 [a]
5	4.4 [a]	4.0 [b]	4.1 [b]	4.5 [a]
6	4.4 [a]	3.8 [b]	3.8 [b]	4.5 [a]

Mean with the same subscripts on the same column are not significantly ($P > 0.05$) different.

Table 3 shows the sensory evaluation scores for the 100% gari. A significant difference ($P < 0.05$) was noted in the taste.

Table 4: Mean Sensory Scores of the Soy-gari.

No of month	Colour	Flavour	Texture	General Acceptability
0	4.6 [a]	4.5 [a]	4.3 [a]	4.5 [a]
1	4.6 [a]	4.4 [a]	4.3 [a]	4.5 [a]
2	4.5 [a]	4.3 [a]	4.1 [a]	4.4 [a]
3	4.3 [a]	4.3 [a]	3.9 [a]	4.4 [a]
4	4.3 [a]	4.0 [b]	3.9 [a]	4.3 [a]
5	4.2 [b]	3.9 [b]	3.7 [b]	4.2 [a]
6	4.2 [b]	3.8 [b]	3.6 [b]	3.9 [b]

Mean with the same subscripts on the same column are not significantly ($P > 0.05$) different.

Table 4 shows the mean sensory evaluation scores for soy-gari sample. A significant difference ($P < 0.05$) was noted in the taste, texture

and general acceptability of the sample.

Discussion

Physico-chemical properties of 100% gari and soy-gari samples (Tables 1 and 2) respectively showed that water absorption capacity (WAC) decreases slightly as storage time increases for both 100% gari and soy-gari.. This could be attributed to the moisture absorption and is also in accordance with that reported by Salwin (1983) which stated that the possible hydrolysis of starch molecules would lead to reduction in starch concentration and consequently to a reduction in water absorption capacity with increasing storage time.

The least gelation concentration (LGC) of both 100% gari and soy-gari samples had no noticeable change throughout the storage time. This can be related to solute concentration of the samples since gelation is a function of concentration and also to the nature of the protein and the presence of some seed coat fractions in the samples.

The bulk density of both 100% gari and soy-gari samples increased as the storage time increased. The increase in bulk density could be as a result of moisture intake. This is in accordance with that reported by Malleshi, Datidu & Chanderesekhara, (1989) which noticed that bulk density of soy-millet blend increased with storage time when stored in room temperature.

An increase was noticed in the pH and free fatty acid for both 100% gari and soy-gari samples. This could be attributed to the rancidity and hydrolysis of the salts in the samples. However, a decrease was noticed in the total titratable acidity for both 100% gari and soy-gari samples. This could be attributed to the moisture intake and absence of lactic acid producing bacteria. This is also in accordance with that reported by Achi (1990) which stated that increase in moisture content of a stored product lead to decrease in total titratable acidity.

Generally, an increase was noticed in the moisture contents for both 100% gari and soy-gari samples. This could be attributed to the hygroscopic nature of the products and the nature of the storage materials used. This also agreed with that reported by Akanbi (1992), which stated that dehydrated foods have larger effective surface areas to exhibit greater hygroscopic behaviour. However, a decrease was observed in viscosity with storage time for both 100% gari and soy-gari samples. This could be attributed to the moisture absorption of the samples. This also agreed with that reported by Synder and Kwon (1987), which stated that as a food product absorbs moisture, so also the viscosity decreases.

During the storage (Tables 3 and 4), a significant difference was noted only in the taste of 100% gari while this was noted in the taste, texture and general acceptability of the soy-gari samples. Though there was no significant difference in the colour of the soy-gari for the six months. Generally, changes were noticed in the sensory properties of the 100% gari and soy-gari samples. This could be attributed to the changes in the physico-chemical properties of the samples during the six months storage.

Conclusion

The results of this study show that soy-gari can be stored in straw bag for six months at ambient temperature without significant difference in the colour. Though there were slight changes in the physico-chemical and other sensory attributes of the product, but the product was still acceptable after six months of storage.

Recommendations

1. More consumer awareness should be created as regards soy-gari being potential good source of food with good source of nutrients and acceptable sensory appeal.
2. Storage studies should be carried out for longer period to further ascertain changes in the physco-chemical and sensory properties already monitored.
3. Since there is need to enhance the traditional post-harvest practices especially in the area of storage of soy-gari. Further research should be carried out to know the best storage material that can prolong the shelf life of soy-gari without any adverse effect on the physico-chemical and sensory properties of the product.

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