



INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY
Evaluation of Sensory Qualities of *Awara* and Performance on Yield and Functional Properties of Fresh and Dried Soy-curd

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Received on: April, 2021

Revised and Accepted on: June, 2021

Published on: July, 2021

ABSTRACT

Aluminium sulphate (sample A), Lime juice (sample B) and Ruwan-tsami (corn liquor, sample C) were used as coagulants to produce *awara*. The three samples were evaluated for their yield, functional properties and sensory qualities. The results revealed that sample lime juice gave the highest yield of 95% followed by corn liquor (sample C), 51% and then Aluminium sulphate (sample A) 48.39%. From the result of functional properties, water absorption, water absorption capacity, oil absorption capacity and swelling capacity of the three sampled show no significant difference at $p < 0.05$. Bulk density increased from 0.64g/ml for sample A, to 0.66g/ml for sample B and 0.68g/ml for sample C. However, result of the sensory analysis in terms of Colour, taste, aroma of all the samples were the same, but the texture and overall acceptability differs. Samples A and C were the most acceptable recording the highest mean value of 6.64.

Keywords: Qualities of *Awara*, Yield, Dry Soy-curd, Functional Properties

1.0 INTRODUCTION

Awara is a soybean-based deep fried snack obtained by coagulating soymilk with suitable coagulant. In China and Japan, the snack is called tofu which is known as *awara* in Northern Nigeria and beske in the Western parts of Nigeria (Addo and Oguntona, 1993). It is processed by first preparing soymilk and further precipitating the milk with a suitable coagulant. The coagulation step is the most important step in the manufacture of *awara* where the coagulant used help to mobilize the protein and oil in the soy milk. Different coagulants are in use in different places; the three main categories of which are salts, acids, and enzymes that can be used either alone or in combination (McHugh, 2016). Coagulants are typically added at concentrations between 1.5 and 5.0 g/kg while stirring the soy milk at temperatures between 60°C and 90°C. Stirring the milk for the first 5 seconds of coagulation improves yields (Rekha and Vijayalakshmi 2013). In Nigeria, enzyme from *Calotropisprocera*, leave water extract or acid based (lime juice, lemon juice) and fermented cereal liquor called *ruwan-tsami* have been used in processing *awara* (Omueti and Jaiyeola, 2006). Others include calcium chloride (CaCl₂), magnesium sulphate (MgSO₄) and Aluminium sulphate (AlSO₄). *Awara* is made by coagulation of soymilk with salt or acid to produce a soy

protein gel, which traps water, soy lipids and other constituents in the matrix. Nutritionally, *awara* is high in protein (50%), low in saturated fat (27%, most of which is polyunsaturated fatty acids), and cholesterol free and it is also a good source of calcium (Rekha and Vijayalakshmi 2013). They are digestible and nutritive products, which also serve as inexpensive protein and unsaturated fatty acids sources human. Soybean products are a good source of proteins, carbohydrates, low in fat and rich in mineral contents, they are part of principal meals in eastern countries. The incorporation of soybean food (*tofu*) into a western diet could be an important means of preventing and treating chronic diseases, such as cancer and cardiovascular diseases (Anderson, 1988). *Awara* is low in calories, rich in essential amino acids, contains beneficial amounts of iron and has no saturated fat or cholesterol (Rekha and Vijayalakshmi. 2013). It is popularly consumed in Nigeria because of the various nutritional and medicinal properties associated with soybean. Soybean is generally considered as a highly versatile grain which has about 365 applications in the formulation of both human and animal foods and also industrial uses. Thus the demand for soya-based products in Nigeria especially among commercial consumers in the food, pharmaceutical and confectioneries industries is

expected to be substantial due to its nutritional and medical attribute such as reduction of cardiovascular disease, osteoporosis, and cancer risks (FDA, 1999). However, due to the time consuming nature of *Awara*, production of dried powder for instant reconstitution and frying will reduce preparation time, increase convenience and extend shelf life of the semi processed product. This can equally pave way for industrialization of the product. In this regard, the determination of suitable coagulant and the characterization of the dried soybean extract for *awara* in terms of its functional properties and the sensory quality of the *awara* produced from the dried powder is essential for process optimization, which form the basis for this research.

2.0 MATERIALS AND METHODS

Soybean seeds (*Glycine max*) of good quality, Aluminium sulphate and lime juice, is obtained from tuesday market in Lapai, Niger State. *Ruwan-tsami* (corn liquor) was sourced from the laboratory of the department of Food Science and Technology, Ibrahim Badamasi Babangida University, Lapai.

2.1 Production of Soy-curd

Soybean seeds were cleaned, sorted and steeped in water (minimum of 20min at high temperature). The steeped soybeans is then drained and washed with potable water and wet milled using attrition grinder and Potable water added to the slurry, and then a cheese cloth is used to separate the soymilk from the slurry. The slurry is mixed with little quantity of water and then filtered to obtain soy milk. The soymilk is subjected to boiling, coagulants of a known volume is then added to it and allowed to curdle until there is a visible separation of the whey from the curd. The mixture (curd and the whey) is then poured into a clean cheese cloth and pressed by application of pressure (external force) to separate the whey from the curd.

2.2 Determination of Soybean Curd Yield

The yield of cheese is calculated based on cheese obtained and the soybean used. The yield calculated by following ways (Hou *et al.*, 1997).

% Yield of fresh cheese

= weight of fresh cheese (g)/weight of soybean (g) × 100

The difference in yield could be attributed to the processing method used, the soaking time, the coagulant used and or the varieties of soybean processed.

2.3 Preparation of Dried Soy-curd powder

The fresh curd were thinly sliced and dried until it attained a safe moisture content of 13%. It is then ground into coarse powder using a laboratory mill which is allowed to cool and then packaged.

2.4 Determination of Functional Properties of the Dried Powder

Water Absorption Capacity: The water absorption capacity was determined by the method of AOAC (2010). 2g (two grams) of the sample powder was weighed into centrifuge tube and 20ml of distilled water was added, the tube was shaken and allowed to stand at room temperature (25°C) for 30mins. Then it was centrifuged for 30min at 200rpm and the excess water was decanted by inverting the tubes, which the weight of the water bound was determined by the difference.

$$\text{Water Absorption Capacity} = \frac{W_2 - W_1}{W_0}$$

Where:

W₀= weight of sample

W₁= weight of tube.

W₂= weight of tube and sample.

2.5 Oil Absorption Capacity

The oil absorption capacity was determined by the method of AOAC (2010). 2g (two grams) of sample powder was weighed into centrifuge tube and 20ml of oil was added, the tube was shaken and allowed to stand at room temperature (25°C) for 30mins. Then it was centrifuged for 30min at 200rpm and the excess oil was decanted by inverting the tubes, which the weight of the oil bound was determined by the difference.

$$\text{Oil Absorption Capacity} = \frac{W_2 - W_1}{W_0}$$

Where:

W₀= weight of sample

W₁= weight of tube.

W₂= weight of tube and sample.

2.5 Bulk Density

The bulk density was determined using the method of AOAC (2010). Twenty grams of sample was weighed into 100 ml of a graduated cylinder. The cylinder was then tapped ten times against the palm. After that, the cylinder was placed on the table and the final volume was read. Bulk density (g/ml) was calculated as follows:

$$\text{Bulk Density} = \frac{W1}{W2}$$

Where:

W1 = Mass of material

W2 = Volume of material after tapping

Swelling Capacity: The swelling capacity was determined by the method of AOAC (2010). The tube containing sample after water has been decant during water absorption capacity was heated in an oven for 24 hours. The dish was then be removed from the oven, cooled in a desiccator and weighed.

$$\text{Swelling capacity (\%)} = \frac{W2 - W1}{W0} \times 100$$

Where:

W₀ = weight of tube after oven heat

W1 = weight of tube

W2 = weight of sample

2.6 Determination of the Sensory Qualities and Acceptability of Awara

2.6.1 Preparation of Awara from Fresh Curd

The fresh soybean curd obtained from the three coagulant types were seasoned with desired ingredient in the ratio of 1:3 of the ingredient to curd, it is then cut into smaller size and deep fried into hot vegetable oil until it develops brown color. The *Awara* is then drop in a colander and allowed to cool and also drip off remaining oil.

2.6.2 Preparation of Awara from Dried Curd

The *awara* powders produced from the three coagulants were seasoned with desired ingredient in the ratio of 1:3 for the powder to ingredient. Water is added to the mixture in the ratio of 3:1 for water to mixture, and egg white is used in the ratio of 1:3 for egg white to the slurry. The mixture is then allowed to stand for 15 minutes before steaming. These enhance softening, swelling properties, and binding efficiency of the powder. After which the curd obtained is allowed to cool for few minutes, cut into desired sizes and deep fried in hot vegetable oil until it develops a brown colour.

2.7 Evaluation of Sensory Properties of Awara

The sensory evaluation of *Awara* is carried out by 11 trained panelists. The samples were evaluated for colour, texture, taste, flavor and overall acceptability. The samples were then rated on a seven-point hedonic scale to find the degree of like and dislike as described by;

Statistical Analysis: The mean and standard deviation is calculated for each parameter analyzed, by using Analysis of Variance (one-way ANOVA) to determine the differences at 95% confidence level ($p < 0.05$) and to separate the means by least significant difference (LSD)

3.0 RESULT AND DISCUSSION

Effects of Coagulants on the Yield of Soybean Curd

The result of yield is shown in table 1 below. The result revealed that there was difference in yield percentage of the samples produced.

Table 1: The Effect of Coagulants on the Yield of *Awara* (%)

Samples	Quantity of soybeans (g)	Weight of fresh curd (g)	Yield%
A (Aluminium sulphate coagulant)	3058	1480	48.39
B (Lime juice coagulant)	3058	2897	95
C (<i>Ruwan-tsami</i> coagulant)	3058	1580	51

Table 1 above show the percentage yield obtained from coagulation of soy milk to produce fresh curd. Lime juice coagulant has the highest yield percentage of 95%, then the *ruwan-tsami* coagulant with 51%, and Aluminium sulphate coagulant is the least with 48.39%. The different in yield could be due to the effect of the coagulant used. Natural coagulant give higher yield and better protein compared with the one produced

from the chemical coagulant. The higher yield in lime juice coagulant (acid) is attributed to the accumulation of high level of moisture content and protein content by the coagulant. It is followed by *ruwan-tsami* coagulant (acid). Although they are both acid the variation in percentage yield is due to the degree of concentration of the acid in the coagulant. Aluminium sulphate coagulant (salt) has the least

yield percentage compared to lime juice and *ruwan-tsami* coagulant. Salt coagulant was able to coagulate rapidly but the yield is low compared to acid coagulant (Hou, *et al.*, 1997). Furthermore salt coagulant forms a denser *awara* by making protein molecules closer due to the loss of moisture during coagulation step (Omueti and jaiyeola, 2006).

Effects of Coagulants on the Functional Properties of Dried Soy-curd Powder

The result on the functional properties of the dried soy-curd is presented in Table 2 below. These include swelling capacity, oil absorption capacity, water absorption capacity and bulk density.

Table 4.3: Functional Properties of Dried Soybean Extract with Different Coagulant.

Sample	WAC	OAC	Swelling Capacity	Bulk Density
A	274.33 ^a ±7.64	197.67 ^a ±43.11	0.66 ^b ±0.01	332.47 ^a ±29.41
B	256.00 ^a ±37.75	211.00 ^a ±15.00	0.64 ^c ±0.01	361.33 ^a ±16.58
C	252.66 ^a ±24.66	216.00 ^a ±5.00	0.68 ^a ±0.01	351.13 ^a ±13.68

Values with same superscripts in the same column are not significantly different at $P < 0.05$, while those with different superscripts are significantly different ($P < 0.05$).

The result shows that there is no significant different ($p < 0.05$) in water absorption capacity, oil absorption capacity, and bulk density of the samples. However, the swelling capacities of all the three samples differ significantly from each other. According to Iwe and Onadipe (2001) the porosity of a product influences the type of package design to be used for a particular product and it could also be used in determine the type of packaging material required for a product. The swelling capacity is used to determine the ability of starch to hydrate under specific condition such as temperature and water availability (Berk, 1992). Water absorption capacity can be used to determine the shelf-life stability of a product.

Reconstitution Ability of Dried Soy-curd

The reconstitution of the dried curd exhibited a remarkable property of the powder. The drying process might have modified the functionality of the powder such that during reconstitution, the particles of the curd could not stick together to give the characteristic meat-like structure of fresh *awara*. The product rather crumbles probably due to loss of binding ability of the protein. This challenge was however, corrected by the addition of a suitable emulsifier to restore the binding property of the protein. Emulsifiers work by

applying hydrophobic, or hydrogen bonding interaction between the bioactive compounds and an encapsulation material. There are different types of emulsifiers including gum Arabic, linseed oils, egg white, agar-agar, starch jellies etc. (Anderson, 1988). Cassava starch was first used, but the product looks more of a thick porridge than *awara*. Egg white was then used and it produced *awara* of good quality comparable to the fresh samples. Hence, it proved to be a suitable binder probably due to its albumin protein content which supports the coagulation of ingredient and formation of structure under high temperature. Albumin is known to hold ingredients together in a cohesive mass thereby assisting with adhesion and ingredient binding by drawing moisture out (Olapade, *et al.*, 2005).

Sensory Evaluation of Awara from Fresh and Dried Soy-curd

The result on sensory evaluation carried out on samples A, A¹, B, B¹, C, and C¹ of soybean curd using 11 trained panelists are presented in table 3 below. The results revealed no significant difference in all the samples in terms of color, aroma, and taste, but texture and overall acceptability showed significant variation among the samples at $p < 0.05$.

Table 3: Comparative sensory analysis of fresh soybean awara and reconstituted awara

Samples	Colour	Aroma	Taste	Texture	Overall Acceptability
A	6.64±0.67 ^a	5.91±0.94 ^a	6.00±0.77 ^a	6.55±0.52 ^a	6.64±0.67 ^a
A ¹	6.00±0.89 ^a	5.82±0.60 ^a	5.82±0.98 ^a	4.82±1.33 ^c	5.64±0.67 ^c
B	6.36±0.92 ^a	6.18±0.98 ^a	5.73±1.01 ^a	5.27±1.27 ^b	6.18±0.98 ^{abc}
B ¹	6.27±0.48 ^a	5.82±0.87 ^a	5.82±0.40 ^a	5.55±1.04 ^b	6.27±0.65 ^{ab}
C	6.45±0.69 ^a	6.09±0.83 ^a	5.82±0.87 ^a	6.18±0.75 ^{ab}	6.73±0.47 ^a
C ¹	6.18±0.75 ^a	6.00±0.89 ^a	5.73±1.01 ^a	4.91±1.22 ^c	5.91±0.54 ^{bc}

Values with the same superscripts in the same column are not significantly different at $p < 0.05$

Key:

Sample A = fresh soybean awara with aluminium sulphate as a coagulant

Sample A¹ = reconstituted soybean awara with aluminium sulphate as a coagulant

Sample B = fresh soybean awara with lime as a coagulant

Sample B¹ = reconstituted soybean awara with lime as a coagulant

Sample C = fresh soybean awara with ruwan-tsami as a coagulant

Sample C¹ = reconstituted soybean awara with ruwan-tsami as a coagulant

Colour

The colour may be as a result of colour compound of soybean. The yellowish colour of soybean is due to the colour compounds such as anthocyanins, isoflavones, and polyphenols compounds.

Taste

The three samples do not differ in taste. The same quantity of ingredients was used to prepare the samples in the ratios of 1:3 of ingredients to *awara*. Another reason may be due to application of the same amount of heat (frying temperature at 190°C) during the processing.

Aroma

The flavor is generally described as bland or beany. The beany or bland is generated during the grinding and cooking process, and either a hot or cold grind can be used to influence the aroma (Borget, 1992).

Texture

The result revealed that there is significant difference ($p < 0.05$) in texture. Sample A (6.55 ± 0.52^a) is of higher quality followed by samples C (6.18 ± 0.75^{ab}), B¹ (5.55 ± 1.04^{bc}) and B (5.27 ± 1.27^{bc}). The higher quality of sample A in texture may be as a result of soybean slurry used in the production of the *awara* because the more it absorbs water the more tender the *awara* becomes. Other variables include slurry cooking temperature, coagulation and other factors that affect texture (Borget, 1992). Sample B and B¹ which are significantly the same in texture may be as a result of the two samples having the same coagulant (lime). Sample C is the second best in texture and the soybean slurry is also suspected for the reason having the best texture and tends to absorb more water. Sample C¹ (4.91 ± 1.22^c) and sample A¹ (4.82 ± 1.33^c) are the least. This may be due to the fact that the dried soybean extract that was reconstituted tends to absorb water less compared to the fresh *awara*. More also, the particle size of the dried extract may also contribute to the texture.

Overall acceptability

The overall acceptability shows that *awara* produced from the fresh soybean slurry is the best. Although, both fresh and reconstituted *awara* produced using lime juice coagulant are the best from the result shown in table 3 above.

CONCLUSION

Soy-curd powder was successfully produced and characterized from soybean extract using different coagulants; Aluminium sulphate, lime juice and *ruwan-tsami* (corn liquor). The result of the analysis showed that *awara* produced from lime juice coagulant has the highest yield compared to those produced from other coagulants. With regard to the functional properties, it determines the ability of starch to rehydrate at certain time and temperature and also determine the shelf life stability of the product. The result shows no significant difference ($p < 0.05$) in water absorption capacity, oil absorption capacity and bulk density but the swelling capacity differs significantly with *ruwan-tsami* coagulated powder having the highest swelling capacity compared to others. The result of the sensory analysis shows no significant difference ($p < 0.05$) in colour, aroma and taste while texture and overall acceptability differed significantly. The reconstitution of *awara* powder to make *awara* was successful with the use of egg white as emulsifier in the ratio of 1:3 of the egg white to the powder which gave an acceptable product with high panelist rating.

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