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NUTRITIONAL QUALITY OF AWARA MADE FROM FERMENTED BANJARA BEANS AND SOYBEAN

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ABSTRACT

Awara, a Nigerian soft cheese analogue produced from soy milk using crude coagulant of citric acid and alum. Soybean and banjara bean were used in this study and were evaluated for their proximate composition, mineral element content, antinutritional factors, *in vitro* protein digestibility and vitamin content using standard procedures. Results obtained indicated that fermented banjara bean *awara* had a protein content of 2.15±0.01%, and fermented soybean *awara* had a protein content of 3.75±0.01%. Fermented banjara beans *awara* and soybean *awara* had a fat content of 5.16±0.01% and 17.13±0.01% respectively. There were significant differences in the mineral element content of both non fermented and fermented banjara bean and soybean *awara.* Level of antinutritional factors showed that both tannin and phytic acid were absent in fermented soybean *awara*. *The in vitro* protein digestibility of non-fermented and fermented banjara bean and soybean *awara* significantly increases with time. Vitamin A contents of fermented banjara and soybean *awara* increased when compared to non-fermented banjara and soybean *awara*, while a decrease was observed in non-fermented banjara and soybean *awara* as compared to fermented banjara bean and soybean *awara*. It can be concluded from this study that fermented soybean *awara* which is free of antinutritional factors is a more suitable source of protein and fat as a local cheese in this part of the world.

Keywords: *Awara, Non-Fermented, Fermented, Proximate, in vitro Digestibility*

INTRODUCTION

Cheese is essentially milk curd-substance formed from the coagulation of milk by rennet, pressed or moulded into a solid mass (Kosikowski and Mistry,1997). Different cheese types originate from the milks of different dairy animals (LaBarbera, 2012). Cheese contains concentrated milk solids, water, rennet, salt and sometimes bacterial cultures and calcium chloride (Farah and Fischer, 2004). Cheese can also be prepared from non-dairy products such as soybean cheese *awara*, (Schaeffer, 2012). Soybean cheese *awara*, is a healthy, rich and less expensive source of nutrient especially for the developing countries (Nazim *et al*., 2013).

Soybean and banjara bean are important global crops providing oil and protein. In Nigeria, it is near perfect food for most producers and users (Lucas Brader, 2000). It is affordable in the market. In little more than two decades, Nigeria has become Africa's largest producer of both soybean and cowpea. They are considered as a good source of protein, i.e., having all the essential amino acids including methionine and lysine (Nazim *et al*.,2013). Soybean and banjara bean are amongst the richest and cheapest source of plant protein. It is relatively low in crude in crude fibre and rich source of vitamin and minerals. There is no denying fact that soybean and cowpea products have many health benefits such as problems associated with protein energy malnutrition.

Tofu, also known as awara in Hausa is an important dietary snack thoughtout Asia, is the most important and popular food product from soybean in Eastern and Southern Asian countries and is gaining an increasing popularity in Western countries as well (Ganiyu and Ekperigin, 2007), it was developed some 2000 years ago and has become the world's most popular soy food product. Tofu, known as *awara* in Hausa, is an unfermented soy product, also known as soybean curd. It is a soft cheese-like food produced by curding fresh hot soy milk with either a salt (calcium chloride or calcium sulphate) or an acid (glucuno-D-lactose). Traditionally, the curdling agent used to make tofu/awara is calcium sulphate. The coagulant produces a soy protein gel, which traps water, soy lipids, and other constituents in the matrix, forming curds. The curds are then generally pressed to remove the excess water and then cut into cubes (Ganiyu and Ekperigin, 2007).

Awara is a cheese analogue made from soybean. It is a product obtained by curdling soy milk from soybean. A coagulant such as vinegar, tamarind fruit extract, lemon juice, alum, or citric acid is used to bring about the curdling of the soy milk. Traditionally, steep water from *ogi* is also used as a coagulant. These curds are pressed to remove excess water, cut into blocks and fried in deep hot oil (Desronches *et al*.,2004). Awara is easy to digest and is substituted for meat, cheese and certain dairy products such as yoghurt, in the diets for dairy-sensitive individuals, vegans and elderly (Ganiyu and Ekperigin, 2007). Based on the coagulant type, awara can be a good source of calcium added to its inherent B-complex vitamins, isoflavones, minerals fibre and unsaturated fatty acid content (Ganiyu and Ekperigin, 2007). It has a very low levels of saturated fat and no cholesterol. It acts like sponge and has the miraculous ability to absorb any flavour that is added to it. Tamarind fruit extracts, vinegar, lemon juice, alum and citric acid are the main coagulants used to precipitate or curdle the casein-like protein, making it easy and possible to separate it from the whey-like protein.

The aim of this study was to determine the, the nutritional quality of *awara* made from fermented banjara bean and soybean.

MATERIALS AND METHODS

The materials used were soybeans (*glycine max*), banjara bean (awara), vinegar, lemon juice, tamarind fruits extracts, alum and citric acid. These materials were purchased from Maiduguri Monday Market, Borno State, and were authenticated by a Botanist from the Department of Biological science, University of Maiduguri.

PRODUCTION OF AWARA

The *Awara* was produced in four (4) ways:

- Production of *Awara* non- fermented banjara bean.
- Production of *Awara* from fermented banjara bean
- Production of *Awara* from non-fermented soybean
- Production of *Awara* from fermented soybean

PRODUCTION OF AWARA FROM NON- FERMENTED BANJARA BEAN

Preparation of Banjara Bean milk: cowpea was steeped in cold water for 10minutes to soften the seed and the banjara bean was then dehulled. They washed separating the hull from the fine grain. The bean was ground into a paste using hammer mill. Water was added and mixed gradually with the paste to form slurry which was the filtered to extract (Banjara bean milk) using a muslin cloth. The sides of the cloth were held in each hand and moved up and down to roll the pulp back and forth it forms a ball. The cloth was twisted tightly and held over a clean container while pressure was exerted onto it to extract the remaining banjara bean milk. Coagulation of banjara bean milk: Banjara bean milk was boiled for 20-25 minutes at 100ºC, the coagulant (citric acid) was added to the cowpea milk forming sediment at the bottom of the pot the sediment part was collected washed and diced and fried in deep hot oil (Fukushima, 1981).

PRODUCTION OF AWARA FROM FERMENTED BANJARA BEAN

Preparation of fermented banjara bean milk: Banjara was soaked in cold water for 72 hours days to ferment it. After the water was discarded, they were washed and drained in clean water. A hammer mill was used to grind the beans into a paste. Water was added and mixed gradually with the paste to form slurry which was the filtered to extract (Banjara milk) using a muslin cloth. The sides of the cloth are held in each hand and moved up and down to roll the pulp back and forth it forms a ball. The cloth was twisted tightly and held over a clean container while pressure was exerted onto it to extract the remaining banjara bean milk. Coagulation of fermented banjara bean milk: Fermented banjara bean milk was heated and boiled for 20-25 minutes. The banjara bean milk forms a sediment at the bottom of the pot. The sediment part was collected washed, diced and fried in deep hot oil (Fukushima,1981).

PRODUCTION OF *AWARA* FROM NON- FERMENTED SOYBEAN

Preparation of soymilk: soybean was soaked in cold water over night for 2-3 hours. When the soybean splits open easily, they were ready to be drained. After then the water was discarded, they were washed in clean water. A hammer mill was used to grind the beans into a paste. Water was added and mixed gradually with the paste to form slurry which was filtered to extract (soy milk) using a muslin cloth. The sides of the cloth were held in each hand and moved up and down to roll the pulp back and forth. The cloth is twisted tightly and held over a clean container while pressure was exerted onto it to extract the remaining soymilk.

Coagulation of soymilk: Soymilk was heated and boiled for 20-25 minutes at 100ºC. The coagulant (citric acid) was added to the soymilk until a good coagulum was formed. when a large white curd are seed floating in a clear yellow liquid called 'whey', the soymilk was completely curdled and ready to be filtered through a clean muslin cloth into a suitable mould. The curdled soymilk was removed from the pot inside the muslin cloth and pressed until the water content was removed to from a block of *Awara*. The block obtained was diced and fried in deep hot oil (Fukushima,1981).

PRODUCTION OF *AWARA* FROM FERMENTED SOYBEAN

Preparation of fermented soymilk: Soybean was soaked in cold water for about 3 days to ferment it. After the water was discarded, they are washed and drained in clean water. A hammer mill was used to grind the beans into a paste. Water was added and mixed gradually with the paste to form slurry which was filtered to extract (soy milk) using a muslin cloth. The sides of the cloth were held in each hand, moved up and down to roll the pulp back and forth. The cloth was twisted tightly and held over a clean container while pressure was exerted onto it to extract the remaining soymilk. Coagulation of fermented soymilk: Fermented soymilk was heated and boiled for 20-25 minutes. The coagulant (citric acid) was added to the fermented soymilk until a good coagulum was formed. when a large white curd are seed floating in a clear yellow liquid called 'whey', the fermented soymilk was completely curdled and ready to be filtered through a clean muslin cloth into a suitable mould. The curdled soymilk was removed from the pot inside the muslin cloth and pressed until the water content was removed to from a block of *Awara*. The block obtained was diced and fried in deep hot oil (Fukushima,1981).

Determination of Proximate Composition.

Proximate analysis (Moisture, Ash, Crude Protein, Crude fat, Crude fiber and Carbohydrate) was determined according to method described by AOAC (2000)

DETERMINATION OF MOISTURE CONTENT

Two (2g) of sample was weighed into a petri dish of known weight and dried to a constant weight at 105ºC for 5 hours in an oven. The dried sample was cooled in a dessiccator and weighed. The difference in weight of the sample was the moisture content.

% moisture = loss in weight of drying/initiate weight of the sample x 100

DETERMINATION OF ASH

A silica dish was cleaned, ignited, cooled (in a desiccator and weighed (W_1). Test substance (5 grams) labeled W_2 was weighed accurately directly into the silica dish. Using a pair of tongs, the weighed samples were placed in a muffle furnace and the temperature was set at 500ºC until fully turned ash (grey colour of ash). Upon ashing, the dish with the ash was removed from the furnace and kept in a dessicator to cool before weighing (W_3).

$$\% \text{ Ash} = \frac{(W_3 - W_1) \times 100}{(W_2 - W_1)}$$

DETERMINATION OF PROTEIN (KJEDAHL METHOD)

DIGESTION

About 2g of the sample was weighed into Kjedahl digestion tubes and 20 ml of sulphuric acid added. The tube was heated in the digestion chamber for 16-18 hours. NaOH was added and the volume was made up to 100 ml by distilled water.

DISTILLATION

Five millilitres (5mls) of Borate were pipetted into a conical flask and 3- 4 bromocresol and methylene indicator was added into the conical flask. Five millilitres of the digested sample were introduced into the distillation flask through the funnel and 15-20 mls of 40% NaOH will then be added into the distillation flask. All the inlets were closed.

The conical flask containing the borate and mixed indicators was placed at the extended tube (outlet) of the distilation unit and 50 – 75 ml of the distillate was collected into the conical flask. This was titrated with the standard HCl.

STANDARDIZATION OF HCL

Five milliliters (5mls) of ammonium solution was pipetted and distilled with about 15 ml of 40% sodium hydroxide solution. The liberated ammonia was collected in a conical flask containing 5 ml of 2% boric acid and 4 drops of mixed indicator. The ammonia solution was titrated with the standard HCl. The amount of HCl required for the titration was the acid factor that was used in the calculations of crude protein content.

The percentage protein was calculated using the formula.

$$\frac{A \times N \times F \times 14.007}{\text{Weight of sample} \times \text{Aliquot taken}} \times 100$$

Where

A = Volume of the acid used

N = Molarity of acid

F = Factor 6.25

DETERMINATION OF CRUDE FAT

Fat was determined by the soxhlet extraction method. About 3 g of each sample was weighed into fat extraction thimbles and covered with cotton wool to prevent splashing of the sample during extraction. The extraction units (tecator soxhlet 1046) was set up and fat was extracted using petroleum ether.

$$\% \text{ extractable fat} = \frac{W_3 - W_2}{W_1} \times 100$$

Where

W_1 = Weight of sample before extraction

W_2 = Weight of sample without fat

W_3 = Weight of flask with fat

DETERMINATION OF CARBOHYDRATE

The carbohydrate (Nitrogen-free extract) content was determined by the difference obtained after the subtraction of total crude protein, fat, ash and crude fibre from the total dry matter.

Percentage of carbohydrate (Nitrogen-free extract)

= 100 - (% moisture + % protein + % ash + % fat + % crude fibre).

TOTAL ENERGY

The total energy value was calculated according to the method of Mohgoub (1999), using the formula:

Total energy (Kcal /100g) =

[(% available carbohydrates x 4) + (% protein x 4) + (% fat x 9)]

DETERMINATION OF MINERAL ELEMENT

Atomic Absorption Spectrophotometer (AAS) AA 6800 series Shimazo Corp was used for the determination of Ca, Cu, Zn, Mg, P, Na, Mn, Fe, Zn and k. Two grams (2 g) of sample was weighed into a crucible and incinerated at 600^0C for 2 hours. The ashed sample was transferred into 100 ml volumetric flask and 100 ml of distilled water was added into it and readings taken on the AAS.

DETERMINATION OF ANTINUTRIENT

Tannin content determination of the non- fermented and fermented banjara bean and soybean awara were determined by the method described by Price and Butler, (1997).0.2g of sample was weight into Erlenmeyer flask, and 10ml of 4% Hcl in methanol was pipeted into the flask. The flask was closed with parapilus and shaken for 20minutes on a wrist action shaker. 1ml of extract was pipetted and 1ml of 1% vanillin and 0.5ml of concentrated Hcl was added. Five test tubes were labelled I, II, III, IV and V to prepare the standard solutions into the five test tubes, 0.1, 0.3, 0.5, 0.7 and 1.0ml of phenol reagent was added respectively. The test tube was made up to 1ml with methanol (8% Hcl in methanol). 1.0ml of 1%vanilin and 0.5ml concentrated Hcl was added to the tubes and made up to 5.5ml with 4% Hcl in methanol/ blank sample was prepared by using 5ml of 4% Hcl in methanol. The absorbance of the standard solutions, sample extract and blank were read using a spectrophotometer at 500nm 20 minutes after incubation.

Calculation:

Au/Cu=Astd/Cstd

Cu=Au/Astd*Cstd=mg/g

Where Au=absorbance of unknown

Cu=concentration of unknown

Astd=absorbance of standard

Cstd= concentration of standard

DETERMINATION OF PHYTIC ACID

Phytic acid content of the raw and processed pearl soybean and banjara beans samples were determined according to the method described by Davies and Reid, (1979). One gram of sample was extracted by taking 40ml 0f 0.5m nitric acid in a conical flask and shaken at 30̊c and 80 revolutions per minutes. the sample were filtered and 5ml of 0.08M ferric chloride was added and boiled for 20minute and filtered. The free iron remaining in the solution was determined

calorimetrically by adding 2ml of 0.005M ammonium thiocynate and the iron binding capacities of the extract was determined by difference. The results were expressed in terms of Mg Fe bound per gram of sample.

DETERMINATION OF *IN VITRO* PROTEIN DIGESTIBILITY

The *in vitro* protein digestibility of the samples was determined according to the method described by Nills (1979). 1ml of 11% trypsin was introduced into three test tube 4ml of phosphate buffer at pH 7.5 was added into each test tube and 1ml of 1% sample was added to all the test tube (labeled as digestibility at 0hour, 1hour and 6hour). The reaction in each test tube was stopped with 5ml of neutralized formalin at 1hour and 6hour. The content of the test tube was filtered using filter paper. The filter papers were dried in an oven at 180.c for 3%hours. The nitrogen of the undigested sample was determined by kjedahl method.

% *in vitro* protein digestibility= $\frac{CP1 - CP2}{CP1}$ X 100

Where;

Cp1= total protein of unprocessed grain

Cp2= total protein after digestion with trypsin

DETERMINATION OF VITAMIN CONTENT

VITAMIN A ASSAY

Source: method adopted from USP 2007 volume 1

Standard preparation: dissolve an accurately weighed quantity of USP vitamin A reference standard in n-hexane and dilute quantitatively and stepwise, if necessary, to obtain a solution having a known concentration of about 15ug (0.015mg) of retinol acetate per ml

Assay preparation: Transfer about 15mg of vitamin ester (retinol acetate or retinyl palmitate), accurately weighed to 100ml volumetric flask, dissolved in and dilute with n-hexane to volume and mix. Pipette 5.0ml of the solution into a 50ml volumetric flask, dilute with n-hexane to volume mix and scan at 210nm.

W.C = $\frac{20}{100}$ X $\frac{1}{10}$ = 0.02mg/ml (modified)

Sample preparation:

Dissolve 1g of the sample in 10ml n-hexane, sonicate for 30min, centrifuge at 2500rpm for 10min and collect the supernant in a cuvette and scan in UV spectrophotometer at 210nm

Using bear lambert's law

A = abc

Where A = absorbance

a= molar absorptivity

b = path length of cuvette

c = concentration

Where ab = constant

Ab standard = C standard

Ab sample = C sample

VITAMIN C ASSAY – BROMOSUCCINAMIDE

SAMPLE PREPARATION

10% solutions of the dried sample were made differently, filtered using filter paper method. 5ml of the filtrate was analyzed for vitamin C (Ascorbic acid).

PROCEDURE

Weigh 0.2g (200mg) Bromosuccinamide in 100ml of warm water to dissolve (stock solution), measure 10ml from the stock solution and make up to 100ml of distill water (working solution), dissolve 0.2g (200mg) ascorbic acid in 1 liter of 1% acetic acid (10ml of acetic acid in that 1 liter) make up to 1 liter.

STANDARDIZE

Take 5ml of standard ascorbic acid and add 1ml conc. Acetic acid. 5ml of 4% KI, add 3ml of dethyl ether, titrate against Bromosuccinamide until brown coloration shown on the ether layer. Take 5ml of your sample instead of standard ascorbic acid and add 1ml of conc. Acetic acid, 5ml of 4% KI, add 3ml of dethyl ether, titrate against Bromosuccinamide until brown color appears on the ether layer.

RESULTS

PROXIMATE COMPOSITION

Proximate composition of non-fermented and fermented banjara and soybean *awara* is shown in Table 1. The moisture, Ash and protein of non-fermented *awara* are (16.08±0.02), (2.10±0.01) and (2.06±0.03). while fermented *awara* had (31.35±0.01), (4.43±0.01) and (3.15±0.01). A significant decrease was observed in the fat, carbohydrate and energy value of fermented banjara (5.16±0.016), (56.91±0.01), and (282.88±0.01) when compared to non-fermented banjara (8.72±0.01), (71.04±0.03) and (370.86±0.09). Soybean *awara* had a significant increase in moisture, Ash, protein and fat of fermented awara (18.92±0.01), (6.47±0.01) (3.75±0.01) and (17.13±0.01) and non-fermented *awara* showed moisture, Ash, protein and fat content of (4.95±0.04), (2.86±0.01), (1.59±0.01) and (14.37±0.02). significant decreases were observed between the carbohydrate and energy levels of non-fermented (76.23±0.02), (440.63±0.09) fermented soybean *awara* (53.73±0.01) and (384.09±0.10) respectively.

Table 1: The proximate composition of raw and fermented soybean and banjara awara

Sample	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrates (%)	Total energy (%)
NFB	16.08±0.2^{a}	2.10±0.01^{a}	2.06±0.03^{a}	8.72±0.01^{a}	71.04±0.03^{a}	370.86±0.00^{a}
FB	31.35±0.01^{b}	4.43±0.01^{b}	2.15±0.01^{b}	5.16±0.01^{b}	56.91±0.02^{b}	282.66±0.00^{b}
NFS	4.95±0.04^{a}	2.86±0.01^{a}	1.59±0.01^{a}	14.37±0.00^{a}	76.23±0.02^{a}	440.63±0.09^{a}
FS	18.92±0.01^{b}	6.47±0.01^{b}	3.75±0.01^{b}	17.13±0.01^{b}	53.73±0.01^{b}	384.09±0.00^{b}

Values are presented in mean ±SEM,

Mean values with different superscript along the column are statistically different ($p<0.05$).

Key:

NFB= Non-Fermented Banjara FB=Fermented Banjara NFS=Non-Fermented Soybean FS=Fermented Boybean

THE MINERAL ELEMENT COMPOSITION OF NON-FERMENTED AND FERMENTED BANJARA BEAN AND SOYBEAN *AWARA*.

Elemental analysis of non-fermented and fermented banjara and soybean *awara*. Calcium, potassium, zinc, magnesium, sodium and iron content of non-fermented banjara bean *awara* ranged from (0.36±0.01), (10.01±0.01), (0.38±0.01), (0.12±0.03) (59.70±0.58) (0.22±0.02) and fermented banjara bean *awara* had (0.12±0.01), (7.02±0.01), (1.06±0.01), (0.39±0.01) (124.30±0.15) and (0.36±0.02) respectively. Non-fermented soybean *awara* had a calcium, zinc, magnesium and potassium levels of (0.22±0.01), (0.31±0.02), (0.70±0.01) and (10.02±0.02) which are higher than that of the fermented soybean *awara* (0.11±0.02), (0.21±0.01), (0.35±0.01) and (8.11±0.01) low levels were recorded for non-fermented soybean *awara* in terms of iron and sodium (0.24±0.01), (18.50±0.06) when compared to fermented soybean *awara* which showed higher values of (0.26±0.01), (99.60±0.12) respectively.

Table 2: The Mineral Element Composition of Non-Fermented and fermented Banjara Bean and Soybean *awara.*

Nutrient	NFB	FB	NFS	FS
Calcium	0.36 ± 0.01^{C}	0.12 ± 0.01^{a}	0.22 ± 0.01^{b}	0.11 ± 0.02^{a}
Copper	0.21 ± 0.02^{a}	0.12 ± 0.01^{b}	0.17 ± 0.01^{c}	0.20 ± 0.01^{a}
Zinc	0.38 ± 0.01^{d}	1.06 ± 0.01^{b}	0.31 ± 0.02^{c}	0.21 ± 0.01^{a}
Magnesium	0.12 ± 0.03^{d}	0.39 ± 0.01^{b}	0.70 ± 0.01^{c}	0.35 ± 0.01^{a}
Phosphorus	0.37 ± 0.01^{d}	0.11 ± 0.01^{b}	0.11 ± 0.01^{cb}	0.25 ± 0.01^{a}
Sodium	59.70 ± 0.58^{d}	124.30 ± 0.15^{b}	18.50 ± 0.06^{c}	99.60 ± 0.12^{a}
Manganese	0.25 ± 0.01^{d}	0.37 ± 0.02^{b}	0.22 ± 0.01^{c}	0.40 ± 0.01^{a}
Iron	0.22 ± 0.02^{d}	0.36 ± 0.02^{b}	0.24 ± 0.01^{c}	0.26 ± 0.01^{a}
Potassium	10.01 ± 0.01^{dc}	7.02 ± 0.01^{b}	10.02 ± 0.02^{c}	8.11 ± 0.01^{a}

Values are presented in mean ±SEM

Values with different superscript along the column are significantly different ($P<0.05$).

Key:

NFB= Non-Fermented banjara FB=Fermented banjara NFS=Non- Fermented soybean FS=Fermented soybean

THE ANTINUTRITIONAL FACTORS OF NON- FERMENTED AND FERMENTED BANJARA BEAN AND SOYBEAN *AWARA*.

Table 3: The antinutrition factors of non-fermented and fermented banjara and soybean *awara.* Both tannin and phytic acid were detected in non-fermented banjara bean *awara,* however no tannin was present in the fermented banjara bean *awara*. There was a presence of both tannin and phytic acid in the non-fermented soybean *awara* while non was detected in fermented soybean *awara.*

Table 3: Antinutritional Factors of Non- Fermented and Fermented Banjara bean and Soybean *Awara.*

Sample	Tannin	Phytic acids
NFB	-	+
FB	-	+
NFS	+	+
FS	-	-

Keys

NFB= Non-Fermented Banjara FB=Fermented Banjara NFS= Non-Fermented Soybean FS=Fermented Soybean

Table 4: The *In vitro* protein digestibility of non-fermented and fermented banjara and soybean *awara*. At one (1) hour digestibility both non-fermented and fermented banjara soybean *awara* were significantly the same but a significant increase was observed at six (6) hours digestibility. The in vitro protein digestibility reveals an increase in time from 1 hour to 6 hours in both non-fermented and fermented samples.

Table 4: *In vitro* Protein Digestibility of Non-Fermented and Fermented Banjara and Soybean *Awara*

Digestibility	**SAMPLE**			
	NFB	**FB**	**NFS**	**FS**
1 HOUR (%)	9.69 ± 0.01^{a}	10.28 ± 0.01^{a}	51.54 ± 0.01^{b}	52.28 ± 0.01^{b}
6 HOUR (%)	8.80 ± 0.01^{a}	48.75 ± 0.01^{b}	28.05 ± 0.01^{a}	58.51 ± 0.01^{b}

Values are mean± SEM,

Values with different superscript along the row are significantly ($p<0.05$) different.

Keys

NFB = Non-Fermented Banjara FB = Fermented Banjara NFS = Non-Fermented Soybean FS = Fermented Soybean

Table 5: The vitamin A and C of non-fermented and fermented banjara and soybean *awara.* There was a significant difference in the vitamin A content of non-fermented and fermented banjara bean *awara* while and increase was observed in the fermented soybean *awara.* Fermented banjara bean awara had low vitamin C (0.53±0.01) while non-fermented banjara bean awara had high vitamin C value (0.79±0.01) non-fermented soybean *awara* had (1.05±0.01) while fermented soybean *awara* had values of (0.79±0.01).

Table 5: Vitamin Content of Non-Fermented and Fermented of Banjara and Soybean *Awara.*

Vitamins (µg/g)	**Sample**			
	NFB	**FB**	**NFS**	**FS**
A	0.12 ± 0.01^{a}	0.13 ± 0.01^{a}	0.12 ± 0.01^{a}	0.46 ± 0.01^{b}
C	0.79 ± 0.01^{a}	0.53 ± 0.01^{b}	1.05 ± 0.01^{a}	0.79 ± 0.01^{b}

Values are mean ± SEM

Values with different superscript along the row are significantly ($p<0.05$) different.

Keys

NFB = Non-Fermented Banjara FB = Fermented Banjara NFS = Non -Fermented Soybean FS = Fermented Soybean

DISSCUSSION

The high levels observed in fermented banjara bean and soybean *awara* might be attributed to the processing technique fermentation. Fermentation increased the availability of protein and also the biochemical changes that occur during fermentation which breaks down proteins by enzymes into simple compounds (Pele *et al*., 2016), (Saleh *et al,* 2015). The increased in ash levels in both fermented banjara and soybean awara might be due to bioavailability of minerals Ramadan *et al*., (2013) reported similar findings. High moisture of both fermented banjara and soybean awara implies that it does not have a long shelf life and cannot be stored for a very long time (Ogbe *et al.,* 2017). The significant decrease exhibited by fermented banjara bean with regard to fat content might be due to dissociation of lipid complexes, Ragab *et al*., 2012 reported similar findings. And lipid play and important role in diet as important energy source. And increase in fat content of fermented soybean was observed and is consistent with the earlier report of

Saleh *et al.,* 2015. Low levels of calcium and potassium in the fermented banjara and soybean *awara* could be as a result of the processing. An increase in essential minerals such as sodium, iron and magnesium in fermented samples could be due to reduction in the antinutritional properties during processing Saleh *et al*, 2015. Since lactic acid fermentation changes a diet of low iron bioavailability to diet of high iron bioavailability Saleh *et al.,* 2015, reported similar findings. Sodium is needed in the body in small amount to help maintain normal blood pressure and normal function of muscles nerves iron is used in the management of iron deficiency anemia since iron is a vital part of red blood cells that carries and release oxygen (Mches Rodger, 1997). Processing (Soaking, dehulling, fermentation) decreased the levels of anti-nutritional factors in both banjara and soybean awara, this is in accordance with the report of Bintu *et al.,* 2015 who reported a decrease in the antinutritional content of cowpea. The low levels of tannin observed may be as a result of enzymatic activity of the organisms whose hydrolyzing ability is enhanced by fermentation Wakil and Kazeem, 2012). The reduction in phytic acid content of awara from both soybean and banjara awara may be due to hydrolysis of phytate by the enzyme phytase which breaks phytate into lower inositol phosphate which are believed to be activated during the fermentation and germination process Wakil and Kazeem, 2012, reported similar work in assessing the quality of weaning food using cereal and legumes. The reduction in tannin could be attributed as a significant effect of soaking, dehulling and fermentation which significantly decrease the effect of tannin which is similar to the findings of (Pele *et al.,* 2016).

The result for *In vitro* protein digestibility at 6 hour shows a higher digestibility rate in fermented *banjara* and soybean and at 1 hour shows that the digestibility of soybean and cowpea protein is low when the only treatment is heating. But further processing including soaking, sprouting, fermentation, grinding and hot water extraction increase digestibility of soybean and cowpea. Protein also varies with the type of modern soybean and cowpea product. Steaming at 100^0C inactivates the anti-nutritional factors in non-fermented soybean and cowpea, thus rendering a maximum protein efficiency ratio. Soy milk and cowpea milk should always be boiled for 5 to 10minute before consumption so that no active haemagglutinins will be present (Loo, 1978). According to Idris and Dabo, 2016, the degree of processing of soybean increases cowpea digestibility.

The result for vitamin content reveals that there was no significant increases or decreases of vitamin content in some samples while there was a significant difference in other samples, this prove the fact that Fermentation does not always result in increased vitamin concentrations since microorganisms that are involved in fermentation process also require vitamin for growth. Some microorganism is well known for producing vitamins, for example, *streptococcus thermophilus*, others does not influence or even consume vitamins, for example, *lactobacilli.* Fermentation conditions such as incubation temperature, length of incubation, and medium further impact the vitamin content of fermented food (Bintu *et al*.,2015).

CONCLUSION

It can be concluded from this study that fermented banjara and soybean *awara* had higher nutritional qualities than the non- fermented samples. However, fermented soybean *awara* which is free of anti-nutritional factors is more suitable of protein and fat as a local cheese.

RECOMMENDATIONS

The following recommendations were made for further studies in order to improve the quality and acceptability of *awara*

- Cost analysis
- Storage stability
- Effect of wet milling and dry milling on the quantity of 'awara'
- Fermentation yield

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