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# Physicochemical, Anti-nutrient and Microbial Assessment of Soybean Flour Sold in Awka, Anambra State, Nigeria

Adeyemisi Tope Victor-Aduloju<sup>1,\*</sup>, Uju Maryjane Ubaka<sup>1</sup>, Muideen Olayinka Abdulsalam<sup>2</sup>, Adeyinka John Olopade<sup>3</sup>

<sup>1</sup>Department of Food Science and Technology, Nnamdi Azikiwe University, Awka, Nigeria

<sup>2</sup>Department of Sales, Nestle Nigeria Plc., Ilupeju Lagos, Nigeria

<sup>3</sup>Department of Revenue, Sheraton Abuja Hotel, Abuja, Nigeria

## Email address:

at.victoraduloju@unizik.edu.ng (A. T. Victor-Aduloju)

\*Corresponding author

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**Abstract:** This study was carried out to evaluate the physicochemical, anti-nutrients and microbial load of soybean flour sold from different locations in Awka, Anambra State Nigeria. The eight soybean flour samples obtained were subjected to physicochemical, anti-nutrient and microbial load test using standard methods. The result obtained was further analyzed statistically using one way ANOVA ( $P > 0.05$ ). The results showed that the physicochemical parameters namely, total titratable acidity ranged from 0.03 - 0.06% with sample FMS having the highest value of 0.06% and the sample NAS having the least value of 0.03%. The viscosity ranged from 19.52 - 22.41Cp and pH 6.45 - 6.75. The FMS sample had the lowest pH value of 6.45 while the sample ARS had the highest pH of 6.75. The anti-nutrient showed that phytate content ranged from 0.60 - 1.04 mg/100g, tannin 1.04 - 1.21 mg/100g, trypsin inhibitor ranged from 4.17-7.33 TIU/g, lectin 3.16 - 4.33 TIU/mg. The functional properties showed that the bulk density ranged from 0.57 to 0.59g/ml and absorption capacity 2.28 - 3.92%. The result for microbial load of soybean flour revealed that the total viable count ranged from  $1.33 \times 10^5$  to  $3.46 \times 10^5$  and the fungal count ranged from  $1.60 \times 10^5$  to  $4.53 \times 10^5$ . It was observed that soybean flour sample (FMS) possessed low anti-nutrients with good functional properties. Also, it has lower microbial load when compared to other samples. The lowest microbial load recorded could be as a result of proper food handling processes.

**Keywords:** Soybean Flour, Physicochemical, Anti-nutrient, Functional Properties

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## 1. Introduction

*Glycine max*, (Soybean) is an important oil seed belonging to the family Leguminosae. It is usually cultivated as a food crop [1]. Recently, soybean is extensively and effortlessly grown for making diverse processed foods [2]. Soybean is one of the important oil and protein crops of the world containing 30 to 45% protein with a good source of all indispensable amino acids [3]. It is a potential food material that contains all essential amino acids that are very important for the proper developments of the body and indeed has higher lysine content in comparison to other plant proteins [4]. Soybean has been consumed in several parts of the world.

According to their different use soybean cultivars are classified as grain- type, which are conventional soybean for oil and animal feeding, and food type which are those for human consumption in fermented foods (Misso, tempeh, and natto) and non-fermented foods tofu, soyflour and soymilk. Soybean oil is highly consumed world-wide and soy milk is often used as a milk substitute to people with lactose intolerance [5]. There is a growing awareness in the growing and utilization of soybean in Nigeria within the last decades [4]. Presently, soybean is incorporated into so many food formulations of both children and adults to enhance nutritional value of foods in preparations such as "dawadawa", allele, moi-moi and akara. Currently, there is

increase in research on plant as sources of protein. Most of these plants are legumes due to the protein content of leguminous plants. Therefore, soybean is seen as an important legume not only because of its high protein content but also due to its nutritional balanced such as amino acid profile [6]. Another unique quality of soybean is its reliable availability and affordable cost. Currently soybean is gaining more popularity as the pressing need to alleviate poverty, improve the menu of malnourished children, revitalizing heart and breast cancer patients, improves good cholesterol level thereby serving as source of high-quality protein food [7]. The presence of anti-nutritional factors in soybean has been observed to have a possibility of reducing the protein digestibility and consequently inhibit its amino acid availability [8]. The ease of processing of soy flour has led to the increase of individuals involved in the processing and marketing of soybean flour in Nigeria. This has also resulted in multiple kinds of soybean flour in the market with varying qualities. Poor handling processes with poor hygienic practices has resulted in wide spread of low-quality soybean products [8]. It is necessary to ensure that the thermal processing techniques applied is sufficient to reduce the anti-nutritional factors to low levels [9]. Most soybeans products have been contaminated by certain microorganisms which cause food borne illness and disease to under aged children in Nigeria (6-36 months) particularly in Awka during weaning. This could be as result of poor handling or processing, use of dirty utensils, and poor storage [10]. Therefore, it is necessary to carry out microbial safety levels and thus to proffer a solution on better ways of handling and processing soybean flour to reduce the risk of inherent diseases caused by poor processing and packaging of soybean products in Awka, Anambra State.

## 2. Materials and Method

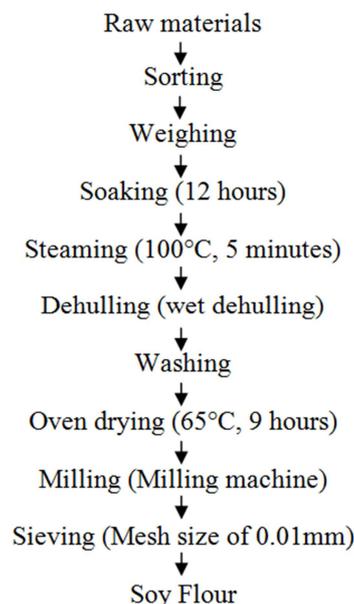
### 2.1. Raw Material Collection

Soybean seed and soybean flour was purchased from Eke-Awka market, soybean flours were purchased from eight (8) different places; Eke-Awka, Temp site, Aroma, First market, Perm site, Nkwo Amenyi, Oye Amansea. The chemical reagents and equipment were sourced from the Department of Food Science and Technology, Nnamdi Azikiwe University, Awka, Anambra State.

### 2.2. Preparation of Soybeans

Soy flour was produced using the method of Tasnim and Suman [11]. Soybean seeds were purchased; sorting was done to remove stones, sands and other foreign materials. Five hundred grams (500 g) of soybean seeds were weighed out soaked in 3 liters of water for 12 hours. The soybeans were brought out from the soaked water and was boiled for 30 minutes to soften the tissues and for easy removal of the seed coat / hulls. It was properly dehulled, washed in clean potable water and was drained using muslin cloth to get rid of excess water. The seeds were dried in a fabricated oven

dryer at 65°C for 9 hours. The dried seeds were milled into flour. The flour was screened through a sieve (0.01mm mesh size) and was packaged for analysis.



Source: Tasnim and Suman, (2015).

Figure 1. Flow Chart to produce Soybean flour.

### 2.3. Physicochemical Analysis

The pH and Total titratable acidity of samples was determined using the method described by AOAC [12] while Viscosity will be determined using the method described by Agume [13].

### 2.4. Determination of Selected Anti-nutrients

#### 2.4.1. Phytate Content Determination

Phytate content was examined by Ojinnaka [14].

#### 2.4.2. Tannin Content Determination

Tannin content of the samples were determined by Folin Denis Coulometric method according to Ojinnaka [14].

#### 2.4.3. Trypsin inhibitor Content Determination

Trypsin inhibitors was determined using the method of Njoku [15].

#### 2.4.4. Lectin Content Determination

This was determined using the method of Njoku [15].

### 2.5. Functional Properties

The Bulk density and Water Absorption capacity was carried out using the method described by Onwuka [16].

### 2.6. Microbial Examination

The apparatus was sterilized in an autoclave at 121°C for 15 minutes and the Petri-dishes were labeled according to codes. Each sample was diluted using distilled water according to the method described by Akintunde and Souley [17].

## 2.7. Statistical Analysis

The data obtained were analyzed according to a completely randomized design with three replicates. Data was subjected to one-way analyses of variance and the differences between means was computed by Duncan's multiple range tests using Statistical Packages for Social Sciences (SPSS) version 23. Significant difference was accepted at  $P < 0.05$ .

## 3. Results and Discussion

### 3.1. Physicochemical Composition of the Soybean Flour Samples

The physicochemical composition of the soybean flour is shown in Table 1. The pH of the samples ranged from 6.60 to 6.75 with sample ARS and ESS having the highest and lowest mean values of 6.75 and 6.45 respectively. There was no significant difference ( $P > 0.05$ ) among samples ARS and OAS.

Total titratable acidity ranged from 0.03 to 0.06%. Samples PSS, SPS, ESS and TSS has the same value of 0.05% each and were not significantly different ( $P > 0.05$ ) while other samples; NAS, OAS, ARS, ESS, ARS with the values: 0.03%, 0.04%, 0.05% and 0.06% respectively differed significantly ( $P < 0.05$ ) from each other samples. However, sample FMS had the highest mean value of 0.06% while sample NAS had lowest mean value of 0.03%.

The values of viscosity of samples ranged from 19.58 to 22.58. The apparent viscosity of the ESS had the highest value of 22.41 cP and the sample FMS had the lowest viscosity value of 19.58 cP. The higher viscosity may be due

to its higher content of denatured protein. The increase in viscosity occurs when starch or starch materials are sufficiently heated in sufficient water which results in gelatinization and swelling of starch granules.

### 3.2. Anti-nutritional Composition of Soy Flour

Phytate content was observed to be in the range of 0.60 to 1.04 mg/100g respectively (Table 2). There was significant difference ( $P > 0.05$ ) among all samples. These values were in line with 1.09 mg/100g recorded by Nwokocha [18]. According to Igile [19] Tannin content was observed to be in the range of 1.04 to 1.21 mg/100g. Sample SSS had highest mean value while sample FSS was lowest. There was no significant difference among samples AMSS, SSS and ASS but differed significantly ( $P > 0.05$ ) from other samples. The level of tannin in the sample was lower than 0.3% specified as maximum standard for legumes by Codex 1990. The low value of tannin may be due to the processing method which removed the pericarp of the seed coats of the legumes. The results showed that trypsin inhibitor of different samples ranged from 4.17 to 7.33 TIU/g. However, the value obtained in this research was slightly in line with the value of Pele [20] that had 5.09mg/100g for pigeon pea and higher than 1.49 TIU/g reported by Nwokocha [18] in soybean. The variation in trypsin inhibitor could be because of nature and the type of raw material used during the period of the sample [21]. The lectin content of the soybeans flour samples ranged from 3.16 to 4.33 IU/mg. Sample TSS contained the highest amount of 4.33 while sample PSS had lowest mean value of 3.16. There was no significant difference ( $P > 0.05$ ) in the control (SPS) and ESS. The result agreed with the finding of Nwokocha [18] with 0.56 IU/mg.

**Table 1.** Physicochemical Composition of Soybean Flour Samples.

Samples	Total Titratable Acidity (%)	pH (%)	Viscosity (Cp)
PSS	0.05 <sup>b</sup> ± 0.01	6.60 <sup>c</sup> ± 0.01	19.52 <sup>d</sup> ± 0.19
NAS	0.03 <sup>d</sup> ± 0.01	6.65 <sup>b</sup> ± 0.01	20.42 <sup>c</sup> ± 0.18
SPS	0.05 <sup>b</sup> ± 0.00	6.61 <sup>c</sup> ± 0.41	21.99 <sup>b</sup> ± 0.02
FMS	0.06 <sup>a</sup> ± 0.00	6.45 <sup>d</sup> ± 0.01	19.58 <sup>d</sup> ± 0.06
EAS	0.05 <sup>b</sup> ± 0.00	6.60 <sup>c</sup> ± 0.01	22.41 <sup>a</sup> ± 0.51
OAS	0.04 <sup>c</sup> ± 0.00	6.73 <sup>a</sup> ± 0.89	22.15 <sup>a</sup> ± 0.61
ARS	0.04 <sup>c</sup> ± 0.00	6.75 <sup>a</sup> ± 0.01	21.22 <sup>b</sup> ± 0.03
TSS	0.05 <sup>b</sup> ± 0.00	6.65 <sup>c</sup> ± 0.046	21.73 <sup>b</sup> ± 0.08

Data are mean and standard deviation of triplicate determinations. Mean with the same superscript letters in the same column are significantly similar ( $P > 0.05$ ).  
Keywords: SPS= Self processed soy bean flour, PSS= Perm-site soy bean flour, TSS= Temp-site soy bean flour, NAS= Nkwo Amenyi soy bean flour, EAS= Eke Awka soy bean flour ARS= Aroma Soy bean flour, FMS= First market Soy bean flour, OAS= Oye Amansi soy bean flour.

**Table 2.** Anti-nutrients Composition of Soybean Flour Samples.

Samples	Tannin (mg/100g)	Phytate (mg/100g)	Trypsin inhibitors {TU/g}	Lectin (mg/100g)
PSS	1.05 <sup>d</sup> ± 0.00	0.66 <sup>d</sup> ± 0.02	6.15 <sup>c</sup> ± 0.46	3.16 <sup>bc</sup> ± 0.01
NAS	1.21 <sup>a</sup> ± 0.01	0.73 <sup>a</sup> ± 0.01	5.67 <sup>d</sup> ± 0.42	3.20 <sup>c</sup> ± 0.37
SPS	1.17 <sup>a</sup> ± 0.02	0.68 <sup>c</sup> ± 0.01	7.33 <sup>a</sup> ± 0.06	3.47 <sup>bc</sup> ± 0.02
FMS	1.04 <sup>d</sup> ± 0.02	1.04 <sup>a</sup> ± 0.02	6.77 <sup>b</sup> ± 0.08	3.23 <sup>c</sup> ± 0.03
EAS	1.09 <sup>cd</sup> ± 0.01	0.70 <sup>b</sup> ± 0.01	5.40 <sup>d</sup> ± 0.07	3.68 <sup>bc</sup> ± 0.05
OAS	1.12 <sup>ab</sup> ± 0.01	0.62 <sup>c</sup> ± 0.01	4.40 <sup>e</sup> ± 0.30	3.96 <sup>ab</sup> ± 0.71
ARS	1.13 <sup>bc</sup> ± 0.01	0.60 <sup>d</sup> ± 0.01	4.17 <sup>e</sup> ± 0.25	3.41 <sup>c</sup> ± 0.01
TSS	1.09 <sup>cd</sup> ± 0.08	0.71 <sup>b</sup> ± 0.01	4.32 <sup>e</sup> ± 0.03	4.33 <sup>a</sup> ± 0.03

Data are mean and standard deviation of triplicate determinations. Mean with the same superscript letters in the same column are significantly similar ( $P > 0.05$ ).  
KEYWORD: SPS= Self processed soy bean flour, PSS= Perm-site soy bean flour, TSS= Temp-site soy bean flour, NAS= Nkwo Amenyi soy bean flour, EAS= Eke Awka soy bean flour ARS= Aroma Soy bean flour, FMS= First market Soy bean flour, OAS= Oye Amansi soy bean flour.

### 3.3. The Total Microbial Load of Soy Flour Samples

The result in table shows that total viable count (TVC) ranged from  $1.33 \times 10^5$  to  $3.47 \times 10^5$  CFU/g with sample AMSS having the highest mean value while sample FSS contained the lowest TVC count. There was no coliform bacterium detected in all samples since the values obtained ranges from 0.00 in SSS to 0.00 in ARSS. This research seems to be an encouraging one because coliform was absent in the samples. The absence of coliform is a good indicator of good manufacturing practices employed by the manufacturers. It

was shown that the result of the fungal count ranges from  $1.60 \times 10^5$  to  $4.53 \times 10^5$  CFU/g. The result of this research was slightly higher than  $1.5 \times 10^4$  CFU/g reported by Agu [22] in soy/acha flour. The result obtained was within acceptable level according to Commission on Microbial Specification of Foods which stated that total plate count between  $0-10^3$  is acceptable between  $10^4$  to  $10^5$  is tolerable and  $10^6$  and above is unacceptable with maximum coliform value of 100CFU/g [23]. The presence of high microbial loads could be because of poor handling practices during production [4].

Table 3. Total Microbial Load of Soy flour Samples.

Sample	Total viable (CFU/g)	Coliform count (CFU/g)	Fungal count (CFU/g)
PSS	$1.40 \times 10^5$	NG	$4.53 \times 10^5$
NAS	$2.50 \times 10^5$	NG	$3.00 \times 10^5$
SPS	$1.70 \times 10^5$	NG	$3.10 \times 10^5$
FMS	$1.33 \times 10^5$	NG	$1.60 \times 10^5$
EAS	$2.96 \times 10^5$	NG	$2.56 \times 10^5$
OAS	$3.46 \times 10^5$	NG	$3.40 \times 10^5$
ARS	$2.96 \times 10^5$	NG	$2.63 \times 10^5$
TSS	$2.30 \times 10^5$	NG	$4.40 \times 10^5$

Data are mean and standard deviation of triplicate determinations. Mean with the same superscript letters in the same column are significantly similar ( $P > 0.05$ ).

#### KEYWORD

NG= No growth, SPS= Self processed soybean flour, PSS= Perm-site soy bean flour, TSS= Temp-site soy bean flour, NAS= Nkwo Amenyi soy bean flour, EAS= Eke Awka soy bean flour ARS= Aroma Soy bean flour, FMS= First market Soy bean flour, OAS= Oye Amansi soy bean flour.

## 4. Conclusion

This study shows the comparison of physicochemical, antinutrients, minerals, functional properties, and microbial loads of different soy flour samples sold in markets in Awka, Awka South Local Government Area.

The tannin and lectin with the values 1.04mg/100g and 3.23mg/100g was also lowest in the soy flour obtained from First Market with acceptable phytate and Trypsin inhibitor of 1.04mg/100g and 6.77mg/100g, low bulk density of 0.57g/ml with good water absorption capacity of 2.60g/ml which made it good flour for infant food formulation. The lowest mesophilic organisms and acceptable fungal count in First market Soy flour showed that it was hygienically processed. The First market Soy flour possessed the best quality parameters which showed that the processors of the flour applied good manufacturing practices and quality control measures.

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