# The development of whole wheat dough meal enriched with soybeans

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**This project was carried out to investigate how much protein source could be incorporated into whole wheat flour without drastically affecting the organoleptic acceptability of the whole wheat meal. The investigation went further to study the effect of soybean flour on the chemical and rheological properties of a whole wheat meal. This involved incorporating dehulled soybean grains milled into flour of 400µm particle size into whole wheat flour of similar particle size. Dehulled soybean was incorporated into whole wheat flour at 10, 20 and 30 % substitution levels. Substitution of soybean in whole wheat dough meal resulted in increase in protein, fat, crude fiber and ash content with a decrease in carbohydrate. Soybean flour also increased the amino acid profile of the dough meal. However, the substitution of soybean flour reduced the gluten content of the dough and it's extensibility with increasing substitution levels of soybeans. The water absorption levels of the mixed flour reduced with increasing levels of soybeans. The substitution of soybean flour into whole wheat flour yielded a dough of higher protein content ranging from 4.53 at 10% substitution level,5.4% at 20% substitution level and 7.5 at 30% substitution level compared to whole wheat dough (control) at 3.78%. Dough meals made from this flour blends also varied in texture, aroma, taste and colour. However, the addition of soybean flour to whole wheat flour in the development of a dough meal produced lesser textural qualities and sensory analysis showed that all the dough samples were generally acceptable but lowest preferred was the dough prepared from the 30% substitution level.**

**Keyword:** Wheat dough meal, soybeans, and rheological properties.

## INTRODUCTION

Dough meals are regular meals taken in this part of the world and other African countries. Dough is a paste made out of any cereal (grains) or leguminous crop by mixing flour with a small amount of water and/or other liquid which is boiled to gelatinization to form a semi solid food product. This process is a precursor to making a wide variety of foodstuffs, particularly breads and bread-based items including pastry, and similar items. In countries in the Sahel region of Africa, ground and boiled dough balls (made from sorghum or millet) are called Aiysh or Biya, but are not roasted (Belderok *et.al.*, 2000). Levened or fermented dough, made from dry ground grain cereals or legumes mixed with water are in use all over the world. In Nigeria the common dough meals are Eba which is made from garri (cassava) and Amala which is made from milled dried yam or plantain flour. Globally, wheat is the source of vegetable protein in human food, having higher protein content than either maize (corn) or rice, and the other major cereals. In terms of total production used for food, it is currently second to rice as the main human food crop, and ahead of maize, after allowing for maize's more extensive use in animal feeds. Much of the carbohydrate fraction of wheat is starch (Zeki, 1992).

Whole wheat dough meal is a choice because of its high fiber content, which assists in the movement of the bowel. Legume proteins are major components of the diet and are increasingly important in human nutrition. Soybean is the most important legume in relation to total world grain production and the most frequently used because of its high protein content and relatively low price (Gupta, 1987).

The addition of soy ingredients to products can improve the protein quality of the product. Consumption of soy foods is increasing because of reported beneficial effects on nutrition and health, such as lowering of plasma cholesterol, prevention of cancer, diabetes and obesity

and protection against bowel and kidney diseases. (Friedman and Brandon, 2001).

This study is intended to enhance the nutritional value of whole wheat dough meal. The essence of this combination is to try as much as possible to enrich the whole wheat with lysine which is a limiting amino acid in whole wheat. The combination of whole wheat with soybean makes an excellent dish for diabetic patients since diabetic patients require lots of fiber and carbohydrate not sugar which is supplied by the whole wheat and they also require low fat and adequate protein source which is supplied by the soybean flour.

Diabetes Mellitus is a disease in which the pancreas produces insufficient amounts of insulin, or in which the body's cells fail to respond appropriately to insulin. Insulin is a hormone that helps the body's cells absorbs glucose (sugar) so it can be used as a source of energy. In people with diabetes, glucose levels build up in the blood and urine, causing excessive urination, thirst, hunger, and problems with fat and protein metabolism (Redmond, 2008). A recommended meal is usually low in fat, provides moderate protein, and contains a variety of carbohydrates, such as beans, vegetables, and grains. For this reason soybean will be used in the preparation of the dough meal (Redmond, 2008). The combination of soybean and whole wheat will make a perfect dish for a diabetic patient because soybean produces the protein required and whole wheat produces the quantity of carbohydrate required and a high level of fiber content. In recent years, research efforts in the developing countries have focused on the improvement of protein quality of cereals and tuber Crops. Various degrees of success has been reported in this area such as fortification of maize with soybean (soy-ogi), cassava with soy flour (cassava - soy flour), fermented yam flour supplemented with soy flour (yam -soy mixture) for "amala", a popular west African food (Adeyemi et al.,1991; Akingbala et al., 1995).

hence this work was aimed at determining the effect of soy flour additions on the chemical and physical properties of whole wheat flour for probable uses in industries and also to evaluate the consumer acceptability of the reconstituted thick paste, a common food in Nigeria.

### Objectives of Study

- To enhance the nutritive value of the dough meal product using a soya/whole wheat composite flour.
- To evaluate the effect of soybean flour on rheological properties of whole wheat dough meal combination.
- To investigate acceptability of the whole wheat soybean meal product.

## MATERIALS AND METHODS

### Procurement of Materials

The whole wheat and soybean grains used in the study were purchased at Ota market Ogun state. Purchased raw materials were stored in the freezer in the laboratory. All Facilities and utensils were sourced from the processing laboratory.

### Preparation of Soy Flour

The flour from soy beans was produced by cleaning, sorting, soaking, dehulling and drying at 70°C for 12hours and milled into coarse particles, winnowed later milled into powder and the obtained flour was sieved in a standard sieve of 400µm particle size. (Fig 1)

### Preparation of Whole Wheat Flour

The wheat was sorted, cleaned, milled into coarse particles and milled again into fine powder after which it is sieved using a standard sieve of 400µm particle size. The obtained flour was packaged in ziploc bags and stored in the freezer. (Fig 2)

### Preparation of Plain and Blend Flours

Whole wheat and soybean flour blend were blended together at different ratios of 90:10, 80:20, and 70:30% of whole wheat flour and soybean flour respectively.
The soy/wheat blends are labelled WWF, WWSB1, WWSB2 and WWSB3 as follows:
WWF: (100% whole wheat flour)
WWSF1: (90:10 whole wheat flour: soybean flour)
WWSBF2: (80: 20 whole wheat flour: soybean flour)
WWSBF3: (70:30 whole wheat flour: soybean flour)

The control, 100% whole wheat dough meal and the three blends were prepared and analyzed independently.

### Storage of the Samples

The samples were stored in Ziploc bags in a deep freezer prior to analysis as show in figure 1 and 2.

### Analytical Procedures

### Proximate Composition

The proximate chemical composition was carried out in

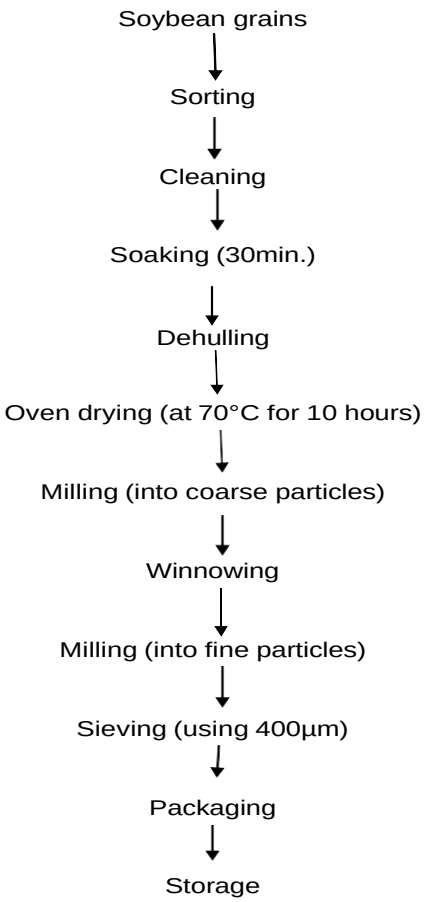


**Figure 1.** Flow diagram for the production of soybean flour (Raji, 2005)

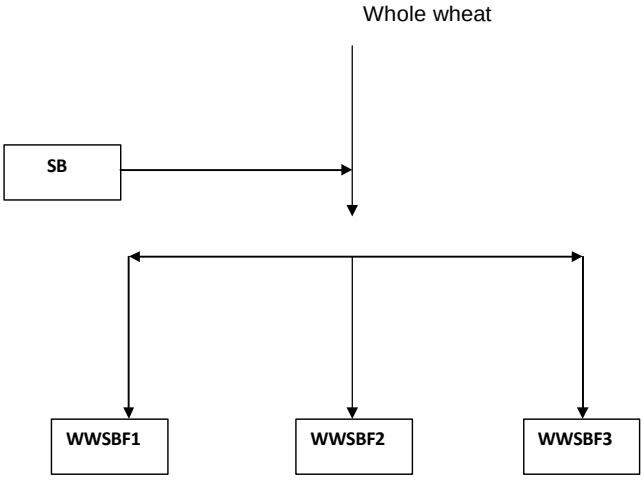


**Figure 2.** Flow diagram for the production of blend. SB = Soybean flour, WWSBF1 = 90% whole wheat + 10% soybean flour, WWSBF2 = 80% whole wheat flour + 20% soybean flour, WWSBF3 = 70% Whole wheat flour + 30% soybean flour

the Food Chemistry Laboratory, and Central Teaching and Research Laboratory of Bells University of Technology, Ota, Ogun State. Moisture contents of the samples were determined by oven drying at 105°C ± 1°C

for 4 hours (AOAC, 1995). The fat content was measured by extraction with petroleum ether in a soxhlet extraction unit (Foss soxhtec 2055 fat extractor) using 2g of the sample. Protein was analyzed as total nitrogen content by kjeldahl apparatus. Crude fibre was determined using the method described by the Pearson (1973). Finally ash content was done using the muffle furnace for 4 hours at 600°C and total available carbohydrate was determined by the difference.

**Proximate Analysis: Ash**

**Procedure**

Sample (2g) of flour/dough meal was weighed in a crucible ignited and tared and transfer to a cool muffle furnace before increasing the temperature step wise to 600°C ± 5°C, this temperature is maintained for 4 hours or until a white ash is obtained. If white ash is not obtained after 4 hours, the crucible with the sample is transferred into the muffle furnace again for another 1 hour. After ashing the crucible is transferred to a desicator and weighed soon after cool.

**Calculation**

The percentage of ash was calculated by the difference between the crucible with the ash and the weight of the crucible divided by the difference of the weight of the crucible and sample and the weight of the crucible multiplied by 100.

$$\% \text{ Ash} = \frac{\text{Weight of crucible and ash - weight of cruci}}{\text{Weight of crucible and (flour/dough) – weig}}$$

**Proximate Analysis: Crude Protein Nitrogen Kjeldahl Methods**

**Procedure**

15 g of $K_2SO_4$, 1 ml of $CuSO_4 \cdot 5H_2O$ catalyst solution and 8-10 boiling chips to digestion flask. (1g) of the sample was weighed and immediately placed in the digestion flask. 15 ml of $H_2SO_4$, was used to rinse any particle on neck of flask down into bulb. Flask was held for digestion and allowed to cool before distilling in the kjeldahl apparatus. A blank was also digested and distilled (all reagents and no sample).

**Calculations**

This is calculated by the difference between the blank and titter multiplied by the normality and 14.00 divided by the weight of the sample in grams.

$$\text{Nitrogen} = \frac{1.400 \times (\text{blank} - \text{titter}) \times \text{normality}}{\text{Sample (g)}}$$

Multiply percent nitrogen by factor 6.25, to calculate percent "crude protein." This is "protein" on a total nitrogen basis (Barbano *et al., 1990*).

**Proximate Analysis: Moisture**

The moisture and low volatile materials are removed by heating at 95-100°C under partial vacuum.

**Procedure**

Moisture can was accurately weighed and approximately 5g of the sample (flour/dough) was weighed into the container and placed in a vacuum oven at 105 °C for approximately 5 hours. The dish was removed from the oven, covered, cooled in desicator, and weighed, re-dry for another 1 hr and repeat process until constant weight has been achieved.

**Calculation**

Percentage moisture was calculated by the difference of the weight of the sample and weight of dried sample (flour/dough) multiplied by 100 divided by the weight of the sample.

% Moisture = 100(p-a)
P where P = weight in g of sample

a = weight in g of dried sample

**Proximate Analysis: Crude Fiber**

Two boiling processes simulate the pH conditions of the digestive tract, acidic in the stomach and alkaline in the small intestine, but nothing more. However, the enzymatic digestion is not simulated.

**Procedure**

Sample (2g) of flour/dough was weighed (W1) in beaker, 1.25% sulfuric acid up to the 150 ml was added. The sample (flour/dough) was boiled for exactly 30 minutes and water was added continuously to the boiling sulfuric acid to maintain the initial point, the boiled sample was washed three times with 30 ml of hot deionized water. After draining the last wash, 150 ml of preheated

potassium hydroxide (KOH) 1.25% was added. It was then boiled for 30 minutes. Water was continuously added to the boiling KOH to maintain the initial point and filtered and washed till it's no longer basic. The last washing was done using cold deionized water aimed to cool the crucibles and then washed three times with 25 ml of acetone. The dry weight was determined after drying in an oven at 105 °C for an hour or up to constant weight and cooled in a desiccator. This weight (W2) represents the crude fiber plus ash content in comparison to initial weight.

**Calculation**

This is calculated by the difference between the weights of the (flour/dough) and the weight of the cup after ashing divided by the weight of the sample multiplied by 100.

$$\% \text{ Crude fiber} = \frac{W2 - W1}{W1} \times 100$$

W1 = Weight of grinded sample , W2 = The crude fiber plus ash content in comparison to initial weight.

**Proximate Analysis: Crude Lipid**

**Procedure**

The Soxtec™ 2055 System represents the new generation of manual Soxhlet extraction systems. It is designed for maximum user convenience through batch handling of six samples at a time. This has been achieved by applying a new patented version of the Soxhlet extraction technique combined with integral solvent handling. The system consists of an Extraction Unit and a Control Unit. The sample (flour/dough) to be analyzed was weighed into thimbles and inserted in the Extraction Unit. The solvent was added in a closed system. The cups are heated by the electrical heating plate. The 4-step extraction procedure consists of boiling, rinsing, recovery and pre-drying. Only 80 ml solvent was used per sample.

**Calculation**

This is calculated by the difference of the weights of the beaker and fat residue in grams and the tare weight of beaker in grams.

$$\% \text{ crude fat} = \frac{(Wres - Wta)}{\text{Weight of sample (g)}} \times 100$$

Wta = tare weight of beaker in grams

Wres = weight of the beaker and fat residue in grams

**Essential Amino Acid Profile Analysis**

The eleven essential amino acids (Phenylalanine, valine, isoleusine, leucine, lysine, tryptophan, methionine cystine, Histidine, Tryrosine and threonine) were obtained by ninhydrin colorimetric method of analysis (Rosen 1957). The extract was suitably diluted to 1ml 0.5ml cyanide acetate buffer was added and 0.5ml of 3% ninhydrin solution in methyl cellosolve. The mixture was heated for 15minutes in $100^0$C water bath. Thereafter, 5ml isopropyl alcohol water mixture as added and shaken vigorously. After cooling, the colour was read in a colorimeter at $570_n$M. The concentration of amino acids was calculated from a standard graph based on known concentration of various amino acids.

**Wet Gluten Determination**

AACC method No 10-11 (AACC, 1984) was used for gluten estimation in plain and blended flours. A weighed sample (25g, 14% moisture) was transferred into a clean dry mixing bowl and 13.5ml of water was added. The contents were formed into a thick dough ball. The dough ball was dipped in water for half an hour and then washed by hand under tap water until free from starch. The wet gluten was thus weighed and its weight expressed as a percentage of the original flour sample (25g).

**Dough Rheological Testing And Measurements**

**Farinograph Testing**

The control flour (wheat flour) and flour blends were tested utilizing the brabender farinograph-E , according to AACC approved method No.54-21 (AACC, 2000). The following parameters were measured from the extensograph curve using the extensograph-E software (v.2.4.4):

- The dough development time (DDT)**:** it's time for the dough to reach maximum consistency (peak).
- Dough water absorption
- Mixing tolerance index (MTI): it's the drop in BU from the top curve at DDT to the top of the curve 5 minutes after DDT.
- Farinograph quality number
- stability time: stability is the time that the top portion of the curve is above the 500BU line

**Extensograph Testing**

The dough extensibility of flour samples was determined using the Brabender- Extensograph®-E (AACC 54-10 /

ISO 5530-2 /ICC 114/1). According to AACC approved method No.54-21 (AACC, 2000). The following parameters were measured from the extensograph curve using the extensograph-E software (v.2.4.4):

- Water absorption (%).
- Energy (Area under the curve) (cm3).
- Resistance to Extension (BU).
- Extensibility (mm).
- Maximum (BU)
- Ratio number.
- Ratio number (Max.).

**Dough Making**

**Dough Meal**

Dough was prepared in the laboratory using the manual method of processing.

**Dough Preparation**

- The whole wheat and soya bean were sorted and milled to a fine powder (separately).
- The fine powders were sieved.
- The various blends were made.
- Water was boiled in a pot on a gas cooker.
- A quantity of the mixed flour (90-10%, 80-20% and 70-30%) was poured in the boiling water and stirred continuously till it gelatinizes into a thick dough.
- A little quantity of water was added to allow the flour cook properly.
- The paste was stirred till a semi solid dough was obtained.

**RESULTS AND DISCUSSION**

**Effect of the Enrichment with Soybean to Whole Wheat in the Production of Dough Meal.**

The proximate compositions of flour from the three blends were presented in (Table 2). It showed a significant increase in the crude protein which increased by 0.55% in the 90:30 blend, 1.70% in the 80:20 blend and by 3.74% in the 70:30 blend. There was also increase in the fat contents; in the 90:10 combinations there was an increase of 0.1%, 0.3% and 0.9% in the whole wheat soybean dough meal respectively. However there was decrease in the crude fiber content, this was because whole wheat contributed the bulk of the fiber and soybean contributed insignificant quantity of fiber. The flour blends (10%, 20%, 30%) decreased in carbohydrate having carbohydrate content of 56.3%, 53.0 and 49.1% respectively with the control (100% whole wheat) having carbohydrate content of 55.8% .
The composite flours prepared by blending whole wheat flour with soy flour were subjected to rheological testing. There was increase in protein content and ash content due to increase in the level of soy flour into wheat flour. The results of the present study suggests that soy flour supplementation improved the nutritional composition of the whole wheat flour and it can be added to whole wheat flour up to 10% without affecting the rheological quality of the dough meal. It is further suggested that from the results, soybean has potential to be used as functional food. Food products that provide some specific health benefits beyond the traditional nutrients they contain are known as functional foods.

**Effect of Soybean Substitution on the Wet Gluten Content of Flour Blends**

The whole wheat had a wet gluten content of 20.4%, which decreased upon blending with soybeans flour (Table 4). This was probably because soybean does not contain gluten, wheat flour with soybeans flour at 70:30 blend had the lowest gluten content of 0.4%.the gluten content is a direct indicator of the flour strength (Dhingra and jood, 2003).
The quantity and quality of the gluten is responsible for the textural property of the dough meal, which makes it a desirable product. Various workers have also observed that the contents of wet gluten decreases with increasing soy flour in wheat flour (Rastogi and Singh, 1989; Singh et al., 1990; Misra et al., 1991).

**Effect of Soybean Flour Substitution on Farinograph Parameters**

The water absorption capacity of the whole wheat was 68.4% (as determined by the farinogram) which decreased upon increasing levels of substitution of soy flour (Table 5). This decrease might be because of reduced level of gluten in soybeans the lowest value was found in flour blends with 70:30 blends which was 60.2%.The effect of soy products on farinograph dough properties is summarized in (Table 5).
The dough development time (DDT) decreased with increased levels of soy flour. With 100% whole wheat the development time was 12.9 minutes, for the 90:10 substitution levels a development time of 15.4 minutes was obtained, at 80:20 substitution level a development time of 12.6 minutes was obtained and at 70:30 substitution levels dough development time of 9.4 minutes was obtained. The dough stability time recorded increased with higher levels of soy substitution; increasing from 7% with whole wheat flour to 17.0% with

**Table 1**. Enrichment of the Whole Wheat Flour

| samples | Soybean (%) | soybean flour (g) | Whole wheat flour (g) |
|---|---|---|---|
| Whole wheat | 0 | 0 | 100 |
| (90: 10) whole wheat flour: soybean flour | 10 | 100 | 900 |
| (80: 20) whole wheat flour: soybean flour | 20 | 200 | 800 |
| (70:30) whole wheat flour: soybean flour | 30 | 300 | 700 |

**Table 2.** Proximate compositon (%) of whole wheat and soybean flour

| Parameters | Whole wheat flour | Soybean flour |
|---|---|---|
| Moisture content | 10.62 ± 0.13 | 9.56 ± 0.01 |
| Crude protein | 10.88 ± 0.10 | 34.68 ± 2.30 |
| Crude fat | 1.63 ± 0.29 | 25.99 ± 2.00 |
| Crude fiber | 12.20 ± 0.12 | 5.20 ± 0.05 |
| Ash | 1.23 ± 0.01 | 5.23 ± 0.32 |
| Carbohydrate * | 63.44 ± 0.13 | 19.86 ± 0.15 |

*By difference

**Table 3.** Proximate compositon (%) of whole wheat and soybean combination

| Parameters | SAMPLES | | | |
|---|---|---|---|---|
| | WW | WWSB1 | WWSB2 | WWSB3 |
| Moisture content | 25.99 ± 0.40 | 26.71 ± 0.16 | 27.07 ± 0.04 | 29.19 ± 0.10 |
| Crude protein | 3.78 ± 0.06 | 4.53 ± 0.04 | 5.48 ± 0.09 | 7.52 ±0.09 |
| Crude fat | 0.13 ± 0.00 | 0.24 ± 0.01 | 0.44 ± 0.01 | 1.08 ± 0.01 |
| Crude fiber | 12.7 ± 0.05 | 13.75 ± 0.10 | 13.18 ± 0.11 | 10.10 ± 0.01 |
| Ash | 1.82 ± 0.00 | 0.44 ± 0.01 | 0.77 ± 0.01 | 0.98 ± 0.11 |
| Carbohydrate * | 55.58 ± 0.10 | 54.33 ± 0.15 | 53.06 ± 1.61 | 51.13 ± 0.11 |

*by difference. WW: (100% whole wheat flour), WWSB1: (90: 10 whole wheat flour: soybean flour), WWSB2: (80: 20 whole wheat flour: soybean flour), WWSB3: (70:30 whole wheat flour: soybean flour).

**Table 4.** Wet gluten content of wheat flour and soybean flour blends

| Samples | Wet gluten (%) |
|---|---|
| (100%) whole wheat flour | 20.4 ± 0.2 |
| (90: 10) whole wheat flour: soybean flour | 18.8 ± 0.4 |
| (80: 20) whole wheat flour: soybean flour | 9.2 ± 0.3 |
| (70:30) whole wheat flour: soybean flour | 0.4 ± 0. |

**Table 5.** Summary of farinograph parameters on whole wheat and soybean flour blends

| Samples | Water absorption (%) | Dough development time (min) | Dough stability (min) |
|---|---|---|---|
| (100%) whole wheat flour | 68.4 | 12.9 | 7.0 |
| (90: 10) whole wheat flour: soybean flour | 65.6 | 15.4 | 14.0 |
| (80: 20) whole wheat flour: soybean flour | 62.3 | 12.6 | 17.4 |
| (70:30) whole wheat flour: soybean flour | 60.2 | 9.4 | 17.0 |

**Table 6.** Summary of extensograph parameters on whole wheat flour and soybean flour blends

| Samples | Water absorption (%) | Energy (CM²) | Resistance to extension (BU) | Extensibility (MIN) |
|---|---|---|---|---|
| (100%) whole wheat flour | 65.5 | 37 | 296 | 66 |
| (90:10) whole wheat flour: soybean flour | 64.5 | 35 | 40 | 50 |
| (80:20) whole wheat flour: soybean flour | 61.5 | 46 | 131 | 38 |
| (70:30) whole wheat flour: soybean flour | 59.5 | 49 | 801 | 31 |

**Table 7**. Amino acid profile of whole wheat dough enriched with soybeans

| NO | Amino acids (g/16gN) | Whole wheat : soybean samples | | | |
|---|---|---|---|---|---|
| | | 100% | 90:10 | 80:20 | 70:30 |
| 1 | Lysine | 2.74 | 2.94 | 3.40 | 3.75 |
| 2 | Theomine | 3.35 | 3.56 | 3.88 | 4.62 |
| 3 | Valine | 4.38 | 4.60 | 4.89 | 4.24 |
| 4 | Methionine | 2.57 | 2.87 | 3.44 | 3.75 |
| 5 | Isolcucine | 4.13 | 4.59 | 4.86 | 5.18 |
| 6 | Leucine | 7.14 | 7.48 | 7.80 | 8.64 |
| 7 | Tyrosine | 4.08 | 4.38 | 4.61 | 5.07 |
| 8 | Phyenylamine | 5.18 | 4.48 | 6.03 | 6.74 |
| 9 | Cystine | 1.82 | 2.08 | 2.51 | 3.18 |
| 10 | Tryptophan | 1.26 | 1.44 | 1.73 | 2.79 |
| 11 | Histidine | 2.18 | 2.37 | 2.69 | 3.68 |

30% substitution.

**Effect of Soybean Flour Substitution on Extensograph Parameters**

Extensibility of the blends using the extensograph decreased as the substitution levels increased (Table 6).This was expected just as (Ribotta, et al.,2005) reported that the incorporation of high levels of soy products had negative effects on the extensibility properties of dough. With higher substitution levels of soybean flour water absorption levels reduced and the energy also reduced, the resistance to extension did not give a particular pattern but tends at increasing Whole wheat gluten is responsible for the extensibility. (Roccia et al., 2009) also reported that soy protein produced more resistant but less extensible mixtures.

**Effect of Soybeaan Substitution on the Amino Acid Profile**

Just as expected the amino acid profile of the several blends increased with increasing soybean flour substitution. Tryptophan has the lowest percentage in whole wheat (control) having a percentage of 1.26% and 1.44%, 1.73%, 2.79% in the flour blends (10%, 20%, 30%) respectively this is shown on (Table 7) . It was found that the tryptophan content of wheat protein was rather low. This is in consonance with Csonka (1986) who discovered that a diet in which wheat is the only source of protein is liable to be deficient in tryptophan. Lysine is the most vulnerable to stress of processing of all the amino acids, because the position of the epsilon amino group was found to increase with increasing level of substitution. A 36.9% increase was obtained, with whole wheat lysine content and 70:30 whole wheat and soybean flour combination. This was in line with report from Kukoyi (2010).

**Effect of Soybean Substitution on Dough Meal Texture**

The textural properties of the blends were expressed as its extensibility. It was generally observed that increasing levels of substitution of whole wheat flour with soy flour reduced the extensibility just like the extensograph predicted. A higher soy/wheat ratio produced very sticky dough which was difficult to handle, as confirmed by the reduction in the area under the curve. This was also confirmed by the work of (Pablo, *et al*., 1990).

**Organoleptic Characteristics**

The blending of whole wheat with soy flour at different substitution levels altered the organoleptic properties of different blends of dough based on the color,

appearance, texture, taste and overall acceptability. Each of the soy flour samples were used to produce whole wheat/soy dough meal for sensory evaluation. The result obtained from the sensory evaluation showed that the 90:10 blend was preferred even more than the whole wheat. From the analysis of variance table it showed that there was no significant difference in the color, flavor and overall acceptability but there was a significant difference in the taste. Reduction in general textural property of the composite flours was in agreement with the report of Famurewa (1998).

### Sensory Evaluation

The multiple comparison tests was chosen for sensory evaluation. The sensory evaluation of samples was carried out by 15 judges. Evaluations of organoleptic properties were made on six point scale rating with respect to texture, colour, flavour/aroma, appearance, taste and overall acceptability. With score 6 denoting excellent attributes and point 1 denoting poor attributes. The whole wheat dough is the reference sample "R" (Larmond, 1977).the samples were coded with three digit random numbers and presented in monadic and random order.

### Statistical Analysis

The four samples obtained from the different fractions of whole wheat soy mixes were made into thick gruels using about 500g of flour and 1500 ml, of boiling water. The samples were rated on the following quality attributes; flavor/aroma, texture, colour, taste and overall acceptability using 6 point hedonic scale. The scores obtained were subjected to analysis of variance (ANOVA) at 5 % level of significance and means separated using Duncan Multiple Range Test.

## CONCLUSION AND RECOMMENDATION

The results from this study indicated that the soybean used in fortifying the whole wheat was able to increase the protein content as well as the crude fiber in the various combinations. However the 90:10 combination has a better rheological property and the protein has been increased and also has a better textural property and extenso property. The overall acceptability of the dough meal made from blend 70:30 received the lowest ratings

It is recommended that refined whole wheat flour could be used instead of the traditionally milled flour to enhance the rheological and organoleptic properties of the meal. Soy flour supplementation in whole wheat flour improved the crude protein content of the composite flour. Fat increased by the supplementation of full fat soy flour into the various blends. The amino acids profile of the whole wheat/soybean dough was also improved by supplementation of soy flour.

It can be concluded that the fortification of whole wheat with soybean can be desirable by flour mills and be sold out to consumers as a nutritious dough food product.

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