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Physico-Chemical and Nutritional Properties of Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends

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Abstract: ***Cookies was produced from wheat (Trititum,spp), acha (Digitaria exilis), and sprouted soybeans (Glycine max) flour blends. The acha and soybeans were processed into flour and used to substitute wheat flour at different level of supplementation with 100:0:0 wheat, acha and sprouted soybeans flour (WASSF) as the control, 60:30:10, 50:40:10, 45:45:10, 40:50:10 and 35:55:10 (WASSF). The physico-chemical and nutritional properties of the cookies were investigated. The vitamins content of the cookies indicate that Thiamine (B1), Carotene equivalent (Vit A), Pyrodoine (B6), Cobalamin (B12), Niacin (B3) and Ascorbic acid (C) ranged from 0.46-0.58 mg/100g, 0.10-0.11 µg/100 g, 4.55-15.10 mg/100g, 0.11-0.28 µg/100g, 6.76-14.00 µg/100g and 0.60-0.61 mg/100g respectively. There were significant differences (p<0.05) in Thiamine, Pyrodoine and Niacin, but there was no significant differences (p>0.05) in Beta carotene, Cobalamin and Ascorbic acid. The minerals content of Iron, Zinc, Calcium, Phosphorus and Magnesium ranged from 7.95-31.33 mg/100g, 3.35-25.03 mg/100g, 32.29-72.34 mg/100g, 250.80-326.80 mg/100g and 59.14-110.26 mg/100g. There were significant differences (p<0.05) observed at both interval of 1h and 6h in the in-vitro protein digestibility from the cookie; The values ranged from 86.15-90.12 % at 1h and 87.25-92.23 % at 6h respectively.***

Keywords: Cookies, Supplemented, sprouting, physico-chemical and in-vitro digestibility

1. Introduction

In recent years, government has through intensive collaboration with research institutes encouraged the use of composite flours in the production of cookies and related food products such as bread. (Racheal and Margaret, 2016).

Composite four can be described as a mixture of several fours obtained from root, tuber, cereal and legume, with or without the addition of wheat four, which is created to satisfy specific functional characteristics and nutrient composition. Most developing countries including Nigeria rely on importation to get wheat or wheat flour needed for making bread, rolls, biscuits and other pastry products. For this reason, most developing countries were interested in the possibility of replacing the wheat needed for making baked goods, wholly or partly with flour obtained from home grown products. The composite flours from cereals such as *acha* are known to be rich in protein and minarals (Abdel-kader, 2000).

Wheat (*Triticum* spp) is a staple food used to make flour for leavened, flat and steamed breads, cookies, cakes, pasta, spaghetti, macaroni, noodles, couscous and also for fermentation to make beer, alcohol, vodka or biofuel (Abulude, 2005). The most obvious result of such blending is that the mixture is higher in protein than the cereal component alone. The legumes usually improve the quality of cereal protein by supplementing them with limiting amino acids such as lysine and sometimes tryptophan and threonine (Chinma, 2012).

Soybeans *(Glycine max)* a grain legume, is one of the richest and cheapest sources of plants protein that can be used to improve the diet of millions of people especially the poor and low income earners in developing countries because it produces the greatest amount of protein used as food by man. Soybeans is an excellent source of protein (40-45%); hence the seeds are the richest in food value of all plant food consumed in the world; Soybean has 3% lecithin, which is beneficial for brain development (Akubor and Ukwuru, 2005).Soya bean is one of the most important oil and protein crops of the world; It is an excellent source of protein because it contains all the essential amino acids, is very rich in minerals and is a good source of fat soluble vitamins (Alabi *et al.,* 2007).

Sprouting is form from seeds during germination of seeds. The sprouts are outstanding sources of protein, vitamins and minerals and they contain such in the respect of health-maintaining important nutrients like glucosinolates, phenolic and selenium-containing components in the isonflavons in the soyabean. As the sprouts are consumed at the beginning of the growing phase, their nutrient concentration remains very high; Sprouted soybean contains high amounts of essential and non-essential amino acids (Kim *et al*. 2013). In addition, anti-nutritional factors like hemagglutinin, trypsin inhibitors, and lipoxygenase decrease during sprouting (Shi *et al*. 2010).

Acha (*Digitaria Exilis)* is a cereal, traditionally consumed whole as "*tuwo*", couscous, "*gwate*", *achajollof* and *kununacha* (Jideani, 1990). *Acha* is reported to have a high pentosan (3.3%), hence, a high water absorption capacity that could be utilized in baking (Lasekan, 1994). *Acha* is rich in micronutrients like iron and iodine (28.5mg/100ml and 22.9mg/100ml respectively) and has about 73% carbohydrates (Oburuoga, 2012). *Acha* is considered as health grains in a sense that they are often consumed whole and are gluten-free (Jideani, 2011). *Acha* is uniquely rich in

methionine andcystine and evokes low sugar on consumption; an advantage to diabetics (Ayo, 2006).

This study was carried out to produce cookies of high and acceptable nutritional quality from wheat, acha and sprouted soybeans composite flour based on their high nutritional benefits.

2. Materials and Methods

The wheat flour (*Triticum eastrum)* and yellow type of soybeans (*Glycine max*) were purchased from kaura Namoda main Market Zamfara State. The*Acha* (*Digitaria exilis* Staph) grains, was purchased from Tudun wada main market, Jos, plateau State of Nigeria. The raw materials were properly cleaned by removing extraneous matter prior to their subjection to different processing treatments.

Preparation of *Acha* Flour

Acha flour was produced using the method of (Ayo, 2007). *Acha* grains were winnowed to remove chaff and dust. Adhering dust and stones were removed by washing in water (sedimentation) using local calabashes. The washed and destoned grains were dried in a cabinet drier at 45°C to a moisture content of about 12%. The dried grains were milled using attrition milling machine and the flour sieved to pass through a 0.4mm mesh size. The *acha* flour was packaged in air tight containers for use as presented in Figure 1.

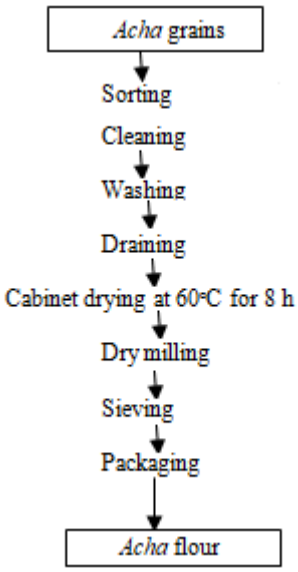

Figure 1: Flow chart for *acha* flour production.
Source: (Ayo, 2007)

Processing of Sprouted Soybeans Flour

Sprouting soybeans flour was produced using the method of (Iwe, 2003) as shown in Figure 2. Soybean seeds (2000 g) were sorted, cleaned, washed and soaked overnight in a stainless steel bucket containing clean tap water. The soybeans were spread on a clean jute bag and covered to screen from direct sun light. Water containing small amount of calcium hypochlorite ($CaClO_4$) to discourage the growth of microorganisms, water was sprinkled twice a day at the intervals of nine (9) h. The seeds were allowed to germinate for 96 h at room temperature and cabinet dried at 60°C for 8 h, devegetated by hand rubbing, winnowed and milled into flour using hammer mill (Bremmer, Germany). The flour was sieved with the aid of a 425 µm sieve to obtain a uniform particle size of flour which was packaged in polyethylene bag and stored at 4-6°C till needed.

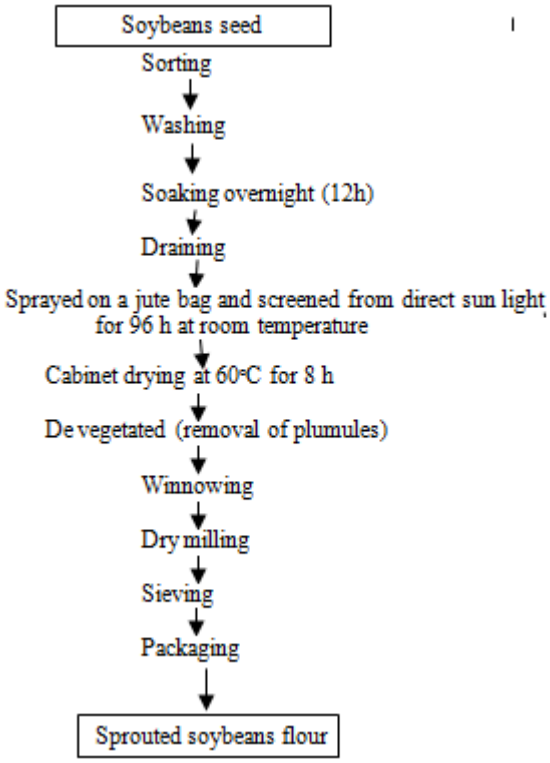

Figure 2: Flow chart for the production of sprouted soybeans flour
Source: (Iwe, 2003)

Formulation Blends of Wheat *Acha* and Sprouted Soybeans Flours

Based on the proximate compositions, wheat, sprouted soybeans and *acha* flour was used for the production of cookies formulation. The different wheat, sprouted soybeans and *acha* blends formulated for the cookies are shown in the Table 1.

Table 1: Recipes for Blends of Wheat, A*cha* and Sprouted Soybeans Cookies

Sample code (WASSF)	wheat flour (%)	*Acha* flour (%)	sprouted soybeans flour %)	Sugar (g)	Fat (g)	Baking powder (g)	Milk (g)	Salt (g)
100:0:0	100	00	00	120	250	1	50	1
60:30:10	60	30	10	120	250	1	50	1
50:40:10	50	49	10	120	250	1	50	1
45:45:10	45	45	10	120	250	1	50	1
40:50:10	40	50	10	120	250	1	50	1
35:55:10	35	55	10	120	250	1	50	1

Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

Production of Cookies

The method described by Ndife *et al.*,(2014) with modification was used in the production of blends of wheat, *acha* and malted soybean flour cookies. Sugar (120g) was added to 250g of margarine in a Kenwood mixer and mixed at medium speed until fluffy. Milk powder were added while mixing and then mixing continued for about 30 min. Sifted flour blends, baking powder were slowly added to the

mixture; and treaded to form dough. It was then rolled on a flat rolling board sprinkled with flour to a uniform thickness of about 0.4cm; circular cookies of 5.8 – 6.0cm diameter were cut, placed in oiled baking trays and baked in the oven at 160°C for 15 min. Other samples with different blends ratio and the control with 100% wheat flour were baked in the same manner.

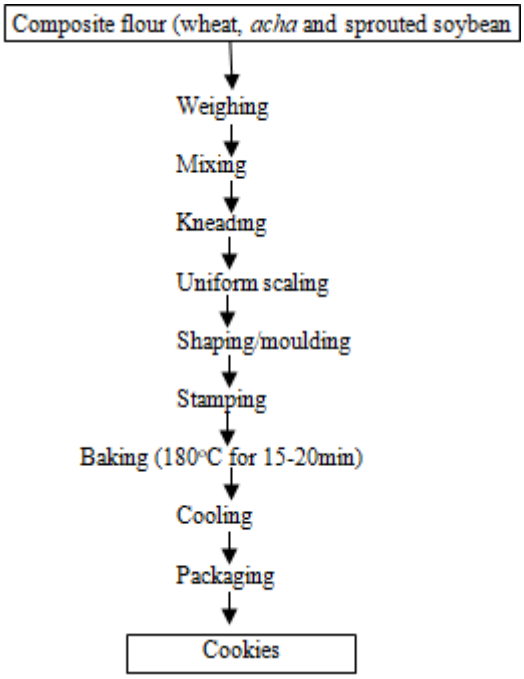

Figure 3: Flow Chart for the Production of Cookies from wheat, *acha* and sprouted soybean
Source: Ndife *et al.*,(2014) modified

Mineral Contents Determination of the Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends

The cookie samples produced from wheat, *acha* and sprouted soybeans flour blends were subjected to mineral content determination, the K was determined by Flame Photometry and phosphorus by Vanado-molybdate method as described by (AOAC, 2005). While Fe, Mg and Zn were determined by Absorption Spectrophotometer as described by (AOAC, 2005).

Vitamin Contents Determination of the Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends

The cookies samples produced were subjected to vitamin content determination, the ascorbic acid, thiamine, riboflavin, pyridoxine, folic acid and niacin were determined by High Performance Liquid Chromatography (HPLC) as described by (AOAC, 2005)

Determination of Dispensable and indispensable amino Acids of the Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends

The amino acid of the cookies from blends of wheat, *acha* and sprouted soybeans flour was determined by using an automated amino acid analyzer (TVA AAAA: 230 dinkjing UAE, 2014), able to determine Siteen amino acids. Sample (0.5g) soy flour was pasted with 50ml 6N HCl by mortar pestle, filter and filtrate was hydrolyzed for 22-24 hours in a hydrolyzing apparatus. After hydrolyzing HCl was removed from filtrate with distill water for 3-4 times by evaporation in a water bath. After completing the evaporation, the stock solution was prepared and mark up to 25ml in a volumetric flask by using 0.1N HCl. This stock solution was used for the determination of amino acids as outlined by AOAC, (2012).

In-Vitro Protein Digestibility (IVPD) of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

The in-vitro Protein digestibility of the cookies samples were determined using the method of (Nill, 1979). One milliliter of 11% Trypsin was introduced into 3 test tubes. Subsequently, 4 ml of phosphate buffer with pH 7.5 was added to each test-tube and 1 ml of 0.1 NHC1 was also added and allowed to stand to equilibrate, after which 1 ml of 1% sample was added to all the test tubes (labeled as digestibility at 1 and 6 hrs). The reaction in each of the test tube was stopped with 5 ml of neutralized formalin at 60 min and 6 hrs. The content of the test tubes were then filtered using filter paper. The filter papers were dried in an oven at 108°C for 3 hr. The nitrogen of the undigested sample was determined by the Kjedahl method:

$$\%\ \textit{in vitro}\ \text{protein digestibility} = \frac{CP1 - CP2}{CP1}$$

Where CP1 = Total protein of sample;
CP2 = Total protein after digestion with Trypsin.

3. Results and Discussion

Table 2: Minerals Content of the Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends (mg/100g).

Sample Code (WASSF)	Iron	Zinc	Calcium	Phosphorus	Magnesium
100:0:0	7.95^{a}±0.01	3.35^{a}±0.02	32.29^{a}±0.10	326.80^{a}±0.03	110.26^{a}±1.49
60:30:10	11.52^{b}±0.01	9.07^{b}±0.02	58.74^{b}±0.12	306.40^{b}±0.04	104.62^{b}±5.16
50:40:10	18.72^{c}±0.08	15.18^{c}±0.02	65.04^{c}±0.04	284.60^{c}±1.29	82.89^{c}±0.28
45:45:10	22.21^{d}±0.09	17.66^{d}±0.02	68.41^{d}±0.02	272.30^{d}±1.44	72.31^{d}±0.90
40:50:10	25.71^{e}±0.01	21.11^{e}±0.01	70.53^{e}±0.02	261.30^{e}±1.67	64.06^{e}±0.40
35:55:10	31.33^{f}±0.04	25.03^{f}±0.06	72.34^{f}±0.03	250.80^{f}±0.81	59.14^{e}±0.30
LSD	0.13	0.08	0.16	2.67	5.47

Values are means ± standard deviations of duplicate duplications. Means in same column with same superscript are not significantly ($p>0.05$) different
Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

Minerals Contents of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

The mineral content in cookies produced from composite flours of wheat, *acha* and sprouted soybean was presented in Table 2. The results shows significant differences in iron, zinc, calcium, phosphorus and magnesium at $p<0.05$ for samples 100:0:0, 60:30:10, 50:40:10, 45:45:10, 40:50:10 and 35:55:10 wheat, acha and sprouted soybeans (WASSF). The

iron, zinc, calcium, phosphorus and magnesium content ranged from 7.95-31.33 mg/100g, 3.35-25.03 mg/100g, 32.29-72.34 mg/100g, 250.80-326.80 mg/100g and 59.14-110.26 mg/100g respectively.

There were significant differences (P>0.05) between the iron, zinc, calcium, phosphorus and magnesium contents in the cookies. The iron and zinc are critical micronutrients for the growth, development, immunity and health of infants, and are known to be limiting nutrients in the diets of infants and young children (Dewey and Brown, 2003). Iron is needed for the formation of hemoglobin, the component of blood cell that carries oxygen in the blood stream throughout the body (Grosvenor and Smolin, 2002). Adequate iron in the diet is essential to minimize the incidence of iron deficiency anemia, which is considered as the most common nutritional disorder worldwide (Short and Domagalski, 2013).

The calcium values varied significantly (P<0.05) among the cookies from different flour blends Calcium plays important role in blood clotting, muscle contraction and in certain enzymes in metabolic processes (Abulude *et al.*, 2006).

The phosphorus and Magnesium contents of the cookies showed a significant difference p<0.05.phosphorus and magnesium in the diet affects the metabolism of calcium, and other minarals such as potassium and sodium (Grosvenor and Smolin, 2002). It is important for bone health; is needed as a cofactor for numerous reactions in the body and is also essential for nerve and muscle conductivity. Thus, sprouting and *acha* increased the levels of iron, zinc, calcium but decrease the level of phosphorus and magnesium of the minerals in the treated samples.

Table 3: Vitamins Content of Cookies from Wheat,A*acha* and Sprouted Soybeans Flour Blends

Sample Code (WASSF)	B1 (Thiamine) mg/100g	A (Beta carotene equivalent) µg/100g	B6 (Pyrodoine) mg/100g	B12 (Cobalamin) µg/100g	B3 (Niacin) µg/100g	C (Ascorbic acid) mg/100g
100:0:0	0.46^{a}±0.01	0.11^{a}±0.00	4.55^{a}±0.01	0.04^{a}±0.00	6.76^{a}±0.01	0.60^{a}±0.01
60:30:10	0.48^{ab}±0.01	0.10^{a}±0.00	4.67^{b}±0.01	0.28^{a}±0.32	7.88^{b}±0.01	0.60^{a}±0.00
50:40:10	0.47^{a}±0.00	0.11^{a}±0.01	9.02^{c}±0.01	0.09^{a}±0.01	10.45^{c}±0.01	0.60^{a}±0.00
45:45:10	0.50^{b}±0.01	0.10^{a}±0.00	11.21^{d}±0.01	0.11^{a}±0.01	11.89^{d}±0.01	0.60^{a}±0.01
40:50:10	0.53^{c}±0.00	0.10^{a}±0.00	13.22^{e}±0.01	0.14^{a}±0.01	12.27^{e}±0.01	0.61^{a}±0.01
35:55:10	0.58^{d}±0.01	0.11^{a}±0.01	15.10^{f}±0.02	0.19^{a}±0.01	14.00^{f}±0.02	0.61^{a}±0.01
LSD	0.02	0.01	0.02	0.32	0.03	0.01

Values are means ± standard deviations of duplicate duplications. Means in same column with same superscript are not significantly (p>0.05) different

Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

Vitamins Content of the Cookies from Wheat, *Acha* and Sprouted Soybeans Flour Blends

The result of the vitamin content of cookies from wheat, *acha* and sprouted soybeans flour blends is as presented in Table 3: The results shows significant different in thiamine, Beta carotene equivalent, pyrodoine, cobalamin, niacin and ascorbic acid at p<0.05 for samples 100:0:0, 60:30:10, 50:40:10, 45:45:10, 40:50:10 and 35:55:10 wheat, acha and sprouted soybeans (WASSF). The thiamine, Beta carotene equivalent, pyrodoine, cobalamin, niacin and ascorbic acid content ranged from 0.64-0.58 mg/100g, 0.10-0.11 µg/100g, 4.55-15.10 mg/100g, 0.11-0.29 µg/100g, 6.76-14.00µg/100g and 0.60-0.61 mg/100g respectively. vitamin B1 (thiamine) of the cookies samples, there was no significant difference (P>0.05) between sample 100:0:0, 60:30:10 and 50:40:10(WASSF) cookies but there were significant difference (P<0.05) between sample 45:45:10, 40:50:10 and 35:55:10 (WASSF)and the control sample 100% wheat flour had the lowest values 0.6mg and sample 35:55:10 had the highest values of 0.58mg. The high values of vitamin B1 in the samples were attributed to the soybean in the samples. The USDA (2009) showed that soybean has high vitamin B1, content.

Vitamin A is very essential for growth, reproduction, good vision, healthy skin, hair and nail and to balance energy level in the human body. The deficiency of vitamin A in the body causes night blindness. The vitamin A (carotene equivalent) content in the cookies samples ranges from 0.10ug/100g-0.11ug/100g there was no significant difference (p>0.05) between the various cookies samples. The samples with *acha* and sprouted soybeans had values comparable with control 100:0:0(100% wheat), the result of this research does not agree with the results of (Edet *et al.*, 2017). Vitamin A plays beneficial roles in vision, bone growth, reproduction, cell division and cell differentiation (Institute of Medicine, 2001). The vitamin B6 (Pyrodoine) content of the cookies samples blends showed no significant difference (p>0.05) in all the cookies samples. B12 (Cobalamin). Niacin content also showed no significant difference (p>0.05) in all the cookies samples. The substitution of wheat flour with *acha* and sprouted soybeans flour blends slightly showed higher content of all the B vitamins. This could be probably due to the sprouted soybeans which had higher content of these vitamins and probably *acha*flour when compared to wheat.

Vitamin C content of the cookies samples, showed no significant difference between the various cookies samples.The values of the vitamin C content ranges from 0.60mg-0.61mg. the result does not agree with the work of (Edet *et al.*, 2017) Vitamin C is required by the body for maintenance of health, gum, healing of wounds, mopping excess of oxygen from the system and is a powerful antioxidant. Deficiency of vitamin C in the body will cause sore gum and scurvy

Table 4: Indispensable Amino Acids of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends (mg/100g).

Samples Code (WASSF)	100:0:0	60:30:10	50:40:10	45:45:10	40:50:10	35:55:10	LSD
Histidine	1.00^{a}±0.00	1.00^{a}±0.00	1.00^{a}±0.00	1.03^{b}±0.01	1.03^{b}±0.01	1.03^{b}±0.01	0.01
Iso-leucine	1.99^{a}±0.02	2.01^{a}±0.01	4.04^{b}±0.01	4.09^{c}±0.00	4.04^{b}±0.00	4.04^{b}±0.01	0.03
Leucine	3.15^{a}±0.22	3.35^{a}±0.05	10.51^{b}± 0.00	10.60^{b}± 0.01	10.57^{b}± 0.01	6.17^{ab}±6.37	6.37
Lysine	1.73^{a}±0.04	4.72^{c}±0.01	4.52^{b}±0.01	4.49^{b}±0.00	4.49^{b}±0.01	4.49^{b}±0.01	0.04
Methionine	4.49^{a}±0.10	4.56^{a}±0.01	4.51^{a}±0.01	4.53^{a}±0.01	4.56^{a}±0.01	5.12^{b}±0.01	0.10
Phenylalanine	2.01^{a}±0.06	2.12^{b}±0.00	5.72^{c}±0.01	5.72^{c}±0.01	5.83^{d}±0.00	5.93^{e}±0.02	0.07
Threonine	1.60^{a}±0.09	1.80^{b}±0.00	3.72^{c}±0.01	3.70^{c}±0.00	3.73^{c}±0.00	3.72^{c}±0.00	0.09
Valine	1.97^{a}±0.11	2.06^{a}±0.04	5.52^{b}±0.01	5.54^{bc}±0.01	5.61^{bc}±0.00	5.67^{c}±0.01	0.12
Tryptophan	0.39^{a}±0.05	0.59^{b}±0.00	0.62^{bc}±0.00	0.66^{c}±0.00	0.73^{d}±0.00	0.74^{d}±0.01	0.05

Values are means ± standard deviations of duplicate duplications. Means in same row with same superscript are not significantly ($p>0.05$) different
Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

Table 5: Dispensable Amino Acidsof the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends (mg/100g)

Samples Code (WASSF)	100:0:0	60:30:10	50:40:10	45:45:10	40:50:10	35:55:10	LSD
Alanine	1.92^{d}±0.01	1.91^{d}±0.00	1.67^{a}±0.03	1.71^{ab}±0.01	1.74^{bc}±0.03	1.76^{c}±0.01	0.05
Arginine	3.11^{a}±0.05	3.15^{ab}±0.03	3.19^{b}±0.00	3.15^{ab}±0.00	3.19^{b}±0.00	3.19^{b}±0.00	0.06
Aspartic acid	4.99^{a}±0.04	5.01^{a}±0.00	5.01^{a}±0.00	5.00^{a}±0.00	5.09^{b}±0.00	5.09^{b}±0.00	0.04
Glutamic acid	7.87^{d}±0.04	7.88^{d}±0.01	7.50^{a}±0.01	7.68^{b}±0.01	7.76^{c}±0.02	7.75^{c}±0.02	0.05
Glycine	1.80^{a}±0.04	1.89^{b}±0.01	1.99^{c}±0.00	2.06^{d}±0.04	2.08^{d}±0.01	2.04^{d}±0.01	0.05
Proline	2.38^{a}±0.07	2.44^{ab}±0.04	2.43^{ab}±0.00	2.44^{ab}±0.02	2.50^{b}±0.01	2.51^{b}±0.00	0.08
Serine	2.27^{a}±0.08	2.36^{ab}±0.01	2.39^{b}±0.01	2.39^{b}±0.01	2.38^{b}±0.00	2.42^{b}±0.00	0.09

Values are means ± standard deviations of duplicate duplications. Means in same row with same superscript are not significantly ($p>0.05$) different
Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

Indispensable and Dispensable Amino Acids composition of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

The results shows significant different in all the indispensable amino acids such as Histidine, Iso-leucine, Leucine, Lysine, Methioninie, Phynylalanine, Threonine, Valine and Tryptophan at $p<0.05$ for samples 100:0:0, 60:30:10, 50:40:10, 45:45:10, 40:50:10 and 35:55:10 wheat, acha and sprouted soybeans (WASSF). The Histidine, Iso-leucine, Leucine, Lysine, Methioninie, Phynylalanine, Threonine, Valine and Tryptophan ranged from 1.00-1.03 mg/100g, 1.99-4.09mg/100g, 3.15-10.60 mg/100g, 1.73-4.49 mg/100g, 4.49-5.12 mg/100g, 2.01-5.93 mg/100g, 1.60-3.73 mg/100g, 1.97-5.67 mg/100g and 0.39-0.74 mg/100g respectively. The Alanine, Arginine, Aspartic acid, Glutamic acid, Glycine, Proline and Serine ranged from 1.67-1.92 mg/100g, 3.11-3.19mg/100g, 4.99-5.09 mg/100g, 7.50-7.88 mg/100g, 1.80-2.08 mg/100g, 2.38-2.51 mg/100g and 2.27-2.42 mg/100g respectively. Since one of the objectives of the study was supplementing wheat flour with *acha* and sprouted soybean flours in order to increase its essential amino acid. It could be observed that the substitution of *acha* and sprouted soybeans flour blends had indicated higher exceptionally increase contents of the indispensable amino acids in all the cookies samples, especially in isoleucine, leucine, lysine, aromatic amino acids (Phenylalanine), therionine, methionine and valine with the exception of Histidine than the cookies from the control sample 100:0:0(100% wheat flour). Therefore, the Leucine score for these indispensable amino acids such as in sample 60:50:10, 45:45:10 and 40:50:10 (WASSF) was higher than those of the reference protein pattern of (FAO/WHO g/100g protein). On the other hand methionine was higher than pattern of (FAO/WHO, 1985) but Iso-leucine, Phenylalanine, Tryptophan and Valine, are within the score pattern range of (FAO/WHO, 1985), while in terms of the dispensable amino acids, there was no significant difference ($p>0.05$) from alanine, arginine, Glutamic acid, asparted and proline in all the samples. Meanwhile, the major dispensable amino acids found in the cookies sample were aspartic acid, glutamic acid, arginine, proline and glysine. But alanine and glycine was the minor dispensable amino acids. In addition, aspartic acid and glutamic acid were the predominant. The result was relatively comparable with the present data on the amino acid content of the cookies produced from wheat, *acha* and sprouted soybeans flour blends. In this concern, it is worth to mention that *acha* and sprouted soybeans was considered good source of indispensable amino acids, as it contained higher values of the most indispensable amino acids (lysine, isoleucine, leucine, aromatic amino acids (Phenylalanine and tyrosine), therionine and valine) as compared with that reported in the reference protein pattern and with the other tested food samples, nearly to that found in the reference protein pattern of FAO/WHO (1985).

Table 6: *In-Vitro* Protein Digestibility of the Cookies from Wheat, A*cha* and Sprouted Soybeans Flour Blends.

Sample Code (WASSF)	Digestibility at 1hr	Digestibility at 6hrs
100:0:0	86.15^{a}±0.00	87.25^{a}±0.00
60:30:10	86.94^{b}±0.02	88.73^{b}±0.02
50:40:10	87.06^{c}±0.01	89.15^{c}±0.00
45:45:10	88.76^{d}±0.01	89.95^{d}±0.01
40:50:10	89.47^{e}±0.01	91.46^{e}±0.01
35:55:10	90.12^{f}±0.01	92.25^{f}±0.00
LSD	0.03	0.03

Values are means ± standard deviations of duplicate duplications. Means in same column with same superscript are not significantly ($p>0.05$) different

Key: WASSF= Wheat, *Acha* and Sprouted Soybeans flour blends

***In-Vitro* Protein Digestibility Content of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends**

The in-vitro protein digestibility of the cookies are as shown in Table 6. The cookies samples were subjected to *in-vitro* protein digestibility at one and six hours interval, digestibility at 1hr ranges from 86.15-90.12 and digestibility at 6hrs ranges from 87.25-92.25 respectively for all the samples, there was significant difference ($p>0.05$) at both digestibility at 1hr and digestibility at 6hrs respectively. Decreased in the percentage of wheat flour significantly, with an increase in the proportion of *acha* flour at constant percentage of sprouted soybeans, show an increase in the protein digestibility at both 1hr and 6hrs intervals. This result showed that high protein content does not necessarily imply high protein digestibility. Protein digestibility is actually the amount of protein absorbed into the body relative to the amount that was consumed This research indicated that various antinutritional factors such as tannins and phytic acid in soybeans that usually adversely affects protein digestibility are destroyed during sprouting, however this research seems not to agree with the work of (Mubarak, 2005). These results are in conformity with those obtained by (Viswanathan and Ho, 2014) observed an increase in *in-vitro* protein digestibility for sprouted grain due to either reduction of antinutritional factors (tannins, trypsin inhibitors and phytic acid) and/or denaturation of proteins making them more vulnerable to proteolytic enzyme activity (Viswanathan and Ho, 2014). Improvement in the protein digestibility of the cookies samples produced from wheat, *acha* and sprouted soybeans flour blends may be attributed to the modifications that occur in protein during the sprouting. The lactics of natural fermentation have been reported to contain proteolytic bacteria which degrade proteins into simple proteins, peptides and amino acids (Au and Fields, 1981). Reduction in contents of ant nutritional factors during the process of fermentation of pearl millet (Charu and Sehgal, 1991) and (Oshodi *et al.*, 1997) reported that roasting of cowpea may also be partly responsible for the increase in the protein digestibility of the weaning food blends.

4. Conclusion

This study was able to develop composite flour from *acha* and sprouted soybeans flour blends were able to meet the functionality of raw material which determine product quality and process effectiveness. Acceptable cookies were produced from wheat, *acha* and sprouted soybean flour blends. Significant increase was observed from the physic-chemical composition in terms of the vitamins, minerals, indispensable and Dispensable amino acids and in-vitro protein digestibility contents of the cookie. From the research, 30:10, 40:10 and 45:10 of *acha* and sprouted soybeans level of supplementation are hereby recommended to improve the nutritional quality of the cookies especially in developing countries where malnutrition is prevalent at all aged group.

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