EFFECT OF ACHA AND SPROUTED SOYBEANS FLOUR ON THE QUALITY OF WHEAT BASED COOKIES.

ABSTRACT

Cookies was produced from wheat (Trititum,spp), acha (Digitaria exilis), and sprouted soybean (Glycine max) flour blends. The acha and soybean were processed into flour and used to substitute wheat flour at different proportions 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 functional properties of the wheat, acha and sprouted soybean flour blends, physical properties and proximate compositions of the cookies were determined. The functional properties of the flour samples shows that the bulk density, wettability, water absorption capacity, oil absorption capacity and gelatination temperature ranged from 0.63 g/ml-0.99 g/ml, 10.21-12.98 g/sec, 6.53-12.52 g/g, 0.52-0.66 g/g and 63.7-65.1^{o}C, respectively. There were significant differences ($p<0.05$) in all the values. The proximate composition of cookies sample showed that crude protein, crude fat, crude fibre, ash, moisture and carbohydrate content ranged from 12.14-16.48 %, 2.10-3.74 %, 1.76-2.55 %, 2.75-8.61 %, 9.18-9.50 % and 59.37-72.06 % respectively. The physical properties of cookies showed that the weight, diameter, thickness and spread ratio ranged from 15.61-17.11g; 61.59-63.20mm; 9.88-11.99mm and 5.28-6.24 respectively. The reference sample had the highest sensory scores for all the attributes. There was significant difference ($p<0.05$) in the colour, texture and aroma but there was no significant difference ($p>0.05$) in the taste and overall acceptability.

KEYWORDS: Cookies, Acha, Sprouted soybeans, Quality and Composite flour.

1.0 INTRODUCTION

Cookies are traditionally made from soft wheat and are nutritious and convenience foods with long shelf life. Soft wheat flour has been the major ingredient used in the production of cookies and other pastry products, but they can also be made with non-wheat flours such as sorghum, maize, pearl millet, plantain, *acha* grain, Soybean [1]. 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 [2].

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 [3].

Wheat (*Triticum* spp) is a grass that is cultivated worldwide. Globally, it is the most important human food grain and ranks second in total production as a cereal crop behind maize, the third being rice. Wheat grain 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 [4].

Soy bean *(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; Soybeans have 3% lecithin, which is beneficial for brain development [5].

Sprouting is the practice of soaking, draining, and leaving seeds or grains until they germinate or sprout. The increasing interest in functional and healthy food products has promoted the use of germinated soya bean flour in the manufacture of foods for human consumption [6]. It is known that sprouting induces

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increase in free limiting amino acids and available vitamins with modified functional properties of seed components [7. 8]. 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 [9].

Acha (*Digitaria exilis)* is a cereal, traditionally consumed whole as "*tuwo*", couscous, "*gwate*", *achajollof* and *kununacha* [10]. *Acha* is reported to have a high pentosan (3.3%), hence, a high water absorption capacity that could be utilized in baking [11]. *Acha* is rich in micronutrients like iron and iodine (28.5mg/100ml and 22.9mg/100ml respectively) and has about 73% carbohydrates [12]. *Acha* is considered as health grains in a sense that they are often consumed whole and are gluten-free [13]. *Acha* is uniquely rich in methionine andcystine and evokes low sugar on consumption; an advantage to diabetics [14].

The broad objective of this research was to produce and evaluate the quality of cookies from wheat, *acha* and sprouted soybean flour blends to produce composites flours and cookies from wheat, *acha* and sprouted soybean flour blends.

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2. MATERIALS AND METHODS

2.1 Source of raw materials

The wheat flour (*Triticum eastrum)* and yellow type of soybean (*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.

2.2 Processing Methods

2.2.1 Preparation of Acha Flour

Acha flour was produced using the method of [15]. *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 Fig. 1.

Acha grain
↓
Sorting
↓
Cleaning
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Washing
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Draining
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Cabinet drying at $60^{o}C$ for 8 h
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Dry milling
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Sieving
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Packaging
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Acha flour

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Figure 1: Production of A*cha* flour (Modified [15])

2.2.2 Processing of Sprouted Soybeans Flour

Sprouting soybean flour was produced by modifying the method described by of [16] 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 $60^{o}C$ 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 (Endecotts Ltd, London, England) to obtain a uniform particle size of flour which was packaged in polyethylene bag and stored at 4-$6^{o}C$ till needed as presented in Fig. 2.

Soybeans seed
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Sorting
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Washing
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Soaking overnight (12h)
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Draining
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Sprayed on a jute bag and screened from direct sun light for 96 h at room temperature
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Cabinet drying at 60°C for 8 h
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De vegetated (removal of plumules)
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Winnowing
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Dry milling
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Sieving
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Packaging
↓
Sprouted soybeans flour

Figure 2: Production of sprouted soybeans flour (modified [16])

2.2.3 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.

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Table 1: Recipes for Blends of Wheat, Acha and Sprouted Soybeans Cookies

Sample code (WASSF)	wheat flour (%)	*Acha* flour (%)	sprouted soybean 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

2.2.4 Production of Cookies From Wheat, Acha and Sprouted Soybeans Flour Blends

The method described by [17] 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^{o}C for 15 min. Other samples with different blends ratio and the control with 100% wheat flour were baked in the same manner.

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Composite flour (wheat, acha and sprouted soybeans

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Weighing

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Mixing

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Kneading

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Uniform scaling

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Shaping/moulding

↓

Stamping

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Baking (180^{o}C for 15-20minutes)

↓

Cooling

↓

Packaging

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Cookies

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Figure 3: Production of Cookies from wheat, *acha* and sprouted soybean (modified [17])

2.5 Determination of Functional Properties of the Composite Cookies from Wheat, Acha and Sprouted Soybeans Flour blends.

2.5.1 Bulk density

A 50g of the flour sample was weight into a 100 ml measuring cylinder. The cylinder was tapped continuously until a constant volume was obtained. The bulk density (g cm-3) was calculated as weight of flour (g) divided by flour volume (cm^3) [18].

2.5.2 Wettabillity and Gelatinization

The wettability and gelatinization were determined according to the method described by [18].

2.5.3 Water and Oil absorption capacity

Water and oil absorption capacities of the flour samples were determined by Ayo [18] methods. One gram of the flour was mixed with 10 ml of water/oil in a centrifuge tube and allowed to stand at room temperature ($30 \pm 2^{o}C$) for 1 h. It was then centrifuged at 200 x g for 30 min. The volume of water or oil on the sediment water measured. Water and oil absorption capacities were calculated as ml of water or oil absorbed per gram of flour.

2.5.4 Determination of Proximate Composition of the Composite Cookies from Wheat, Acha and Sprouted Soybeans Flour blends.

The proximate analysis (moisture, protein, ash, fat (ether extract), crude and carbohydrate were determined in duplicate using the methods described by [19].

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2.5.5 Determination of Physical Properties of the Cookies from Wheat, Acha and Sprouted Soybeans Flour blends.

The weight of the cookies was determined using Electronic compact weighing balance (model KDBN2010) as described by [19]. The thickness (mm) and diameter (mm) of the cookies were measured with digital vernier calipers with 0.01mm precision according to the method of Ayo *et al*. [15]. And spread ratio was also determined according to the method of spread ratio was determined according to method described by [20].

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2.5.6 Sensory Evaluation of theCookies from Wheat, Acha and Sprouted Soybeans Flour Blends.

Sensory evaluation of the cookies was carried out according to the method described by [21].

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2.6 Statistical Analysis

The Experimental data were subjected to analysis of variance (ANOVA) and means separated by Fisher's least significance difference test using Genstat statistical package, version 17.0.

3. RESULTS AND DISCUSSION

3.1 Functional Properties of Cookie samples from Wheat, Acha and Sprouted Soybeans Flour Blends

The functional properties of wheat, acha and sprouted soybeans flour blends is presented in Table 2: The results showed that the bulk density ranged from 0.63-0.99 g/ml, Wettability ranged from 0.21-12.98 g/sec, Water absorption capacity ranged from 6.53-12.52 g/g, oil absorption capacity ranged from 0.52-0.66 g/g and Gelatinization temperature ranged from 63.7-65.1^{o}C respectively. Bulk density is a function of particle size as particle size is inversely proportional to bulk density [22]. Bulk density is also an important parameter for determining the ease of packaging and transportation of particulate or powdery foods,there was a gradual increase of the bulk density with increase in the addition of *acha* flour with constant percentage of the sprouted soybeans. This results is in agreement with the results of [23] with a bulk density of 0.60g/ml-0.85g/ml. Higher bulk density is desirable for greater ease of dispersibility and reduction of paste thickness; while low bulk density of flour is a good physical attribute when determining transportation and storability.

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The wettability of the flour sample blends are significantly different from each other, which indicated that the particles size of the formulated samples were totally hydrated between 10.21 to 12.96 seconds. With

the highest value of 12.98 seconds in sample 35:55:10 (WASSF) and the lowest value of 10.21seconds in sample 100:0:0(100% wheat flour). This may be due to the small particle sizes of the samples, as well as the hygroscopic nature of the *acha* and sprouted soybeans flour. The cookies wettability increased by allowing more water penetration within its matrix with increasing addition of *acha* and sprouted soybeans flour. This may be due to increased fiber content that has been shown to retain water [24].
The water adsorption capacity decreases with increase in *acha* and sprouted soybean flour. This result conforms to the work of [25], where the WAC decreases with increasing protein content. Water absorption characteristic represents the ability of the product to associate with water under conditions when water is limiting such as dough and pastes. Water absorption capacity represents the ability of the products to associate with water under conditions when water is limiting such as dough's and pastes.
The oil Adsorption capacity (OAC) decreases as the wheat flour content decrease. The contribution of *acha* and sprouted soybean flour on the Oil Adsorption Capacity was the least. Oil absorption capacity is attributed mainly to the physical entrapment of oils. It is an indication of the rate at which protein binds to fat in food formulations [22]. Oil absorption capacity is useful in formulation of foods such as sausages and bakery products. Fat increases the leavening power of the baking powder in the batter and improves the texture of the baked product.

The gelatinization temperature of the flour samples blends generally increased with increasing addition of *acha* and sprouted soybean flour. Increasing fiber content appears to delay gelation and subsequently its temperature. Thus, higher heat energy is required to attain significant gelation. [26] reported that waxy and regular maize gelatinize at 62-72°C, whereas high-amylose starches begin to swell below 100°C, temperatures greater than 130°C are required to fully disperse these starches. This is because more amylose molecules are involved in the crystalline regions of the high amylose starch than in waxy and regular starches [27].

Table 2: Functional Properties of Wheat, Acha and Sprouted Soybeans Flour Blends

Sample Code (WASSF)	**Bulk density (g/ml)**	**Wettability (g/sec)**	**Water absorption capacity (g/g)**	**Oil absorption capacity (g/g)**	**Gelatinization temperature (^{o}C)**
100:0:0	0.63^{a}±0.01	10.21^{a}±0.01	12.52^{a}±0.01	0.66^{d}±0.01	63.73^{a}±0.28
60:30:10	0.69^{b}±0.01	10.64^{b}±0.01	9.85^{b}±0.01	0.62^{c}±0.01	63.97^{ab}±0.05
50:40:10	0.72^{c}±0.01	11.23^{c}±0.01	9.22^{c}±0.01	0.60^{bc}±0.01	63.94^{ab}±0.08
45:45:10	0.83^{d}±0.00	11.88^{d}±0.02	7.85^{d}±0.01	0.57^{b}±0.01	64.16^{b}±0.06
40:50:10	0.93^{e}±0.01	12.32^{e}±0.01	7.36^{e}±0.06	0.53^{a}±0.01	64.59^{c}±0.06
35:55:10	0.99^{f}±0.01	12.98^{f}±0.01	6.53^{f}±0.03	0.52^{a}±0.02	65.12^{d}±0.01
LSD	0.02	0.02	0.07	0.03	0.31

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

Table 3: Proximate Composition of Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

Sample Code (WASSF)	Moisture (%)	Crude protein (%)	Crude fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
100:0:0	$9.18^{a}\pm0.21$	$12.14^{a}\pm0.25$	$2.10^{a}\pm0.17$	$2.75^{a}\pm0.24$	$1.76^{a}\pm0.10$	$72.06^{a}\pm0.47$
60:30:10	$9.47^{b}\pm0.01$	$14.82^{b}\pm0.01$	$2.87^{b}\pm0.01$	$7.22^{b}\pm0.00$	$1.97^{b}\pm0.01$	$63.64^{b}\pm0.05$
50:40:10	$9.45^{b}\pm0.01$	$15.50^{c}\pm0.20$	$3.40^{c}\pm0.00$	$7.56^{c}\pm0.00$	$2.21^{c}\pm0.01$	$61.75^{c}\pm0.03$
45:45:10	$9.50^{b}\pm0.00$	$16.25^{d}\pm0.00$	$3.60^{d}\pm0.00$	$8.25^{d}\pm0.00$	$2.40^{d}\pm0.00$	$60.80^{d}\pm0.00$
40:50:10	$9.45^{b}\pm0.00$	$16.34^{d}\pm0.01$	$3.74^{d}\pm0.02$	$8.50^{e}\pm0.00$	$2.52^{e}\pm0.01$	$60.05^{e}\pm0.04$
35:55:10	$9.45^{b}\pm0.00$	$16.48^{d}\pm0.01$	$3.75^{d}\pm0.00$	$8.40^{e}\pm0.00$	$2.55^{e}\pm0.00$	$59.37^{f}\pm0.01$
LSD	0.21	0.32	0.17	0.24	0.10	0.48

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

3.2 Proximate Composition of the Cookies samples from Wheat, Acha and Sprouted Soybeans Flour Blends

The result of the proximate composition of cookies from wheat, *acha* and sprouted soybeans flour blends is as presented in Table 3: The showed that the moisture content ranged from 9.18-9.50 %, crude protein ranged from 12.14-16.48 %, crude fat ranged from 2.10-3.75 %, ash ranged from 2.75-8.61 %, crude fibre ranged from 1.76-2.55 % and carbohydrate ranged from 59.37-72.06 % respectively. The crude protein content of the cookies samples ranged between 12.14-16.48% lowest values recorded in sample 100:0:0 (100% wheat flour) cookies and the highest value of (16.48%) was recorded in sample 35:55:10 (WASSF) cookies. There were significant differences (P<0.05) among the entire samples except for sample 45:45:10, 40:50:10 and 35:55:10 (WASSF) cookies samples which were not significantly different from each other. The increase in protein content was due to the high content of protein in the sprouted soybean and *acha* flour. Therefore, sprouted soybeans and *acha* flour served a complementary purpose in increasing the protein content of the cookies products based with wheat flour and also helps in providing the limiting protein (lysine and tryptophan). The increases in protein content are within the range with the findings of [28] but do not agree with the value reported by Atobatele, and [29]. The sprouted soybean and *acha* fortified cookies will help to alleviate diseases like kwashiorkor that result from higher carbohydrate and high glycemic index food intake. The crude fat contents of the cookies sampleswere significantly different (p<0.05) amongst six samples. The values of the fat content ranged from 2.10-3.75%. The lowest value was observed in sample 100:0:0 (100% wheat flour) cookies 2.10 % and this is relatively low compared to the values 4.50 % obtained by [23]. The highest value was observed in sample 34:55:10 this could be due to sprouted soybeans added and at different percentage and constant *acha* flour substituted.

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The highest fibre value was recorded in sample 35:55:10 cookies and the lowest value in sample 100:0:0. This result indicated that both *acha* and sprouted flour contain larger amount of crud fiber than wheat flour. This could be the reason that an increasing in fiber content was observed as the proportion of *acha* and sprouted soybean flour were added. Similar result was also observed by [30] in their study of blending wheat flour with residue from king palm processing which contains higher fiber content than wheat flour. This was due to the high content of fibre in the sprouted soybean flour. Fibre is good for the body as it increases the stool bulk by acting as a vehicle for faecal water.
The ash content of the cookies samples increased with increase in the substitution of wheat flour with *acha* and sprouted soybeans 2.75% to 8.50%. Increase in the ash content indicates that the samples with

high percentage of ash will be good sources of minerals. *Acha* seeds are excellent sources of potassium, phosphorus, magnesium, sodium, calcium and iron [31].The ash contents of the cookies samples ranges from 2.75-8.61%. The samples were different at 5% level of significance ($p<0.05$). Sample 35:55:10 Cookies had the highest value of 8.61 % while sample 100:0:0(100% wheat flour) cookies had the lowest value of 2.75 %. Higher ash contents indicated that the mineral content is higher in the *acha* and sprouted soybean flour than in the wheat flour. It was observed that there was an increase in the ash contests of the cookies with increasing level of *acha* and sprouted soybean flour in the cookies samples.

The moisture content for sample 100:0:0 cookies were the least 9.18 % and were significantly different from the other samples. This result is in agreement with [23] who reported moisture contents of 7.24-9.85 % from wheat and full fat soybeans. But not in agreement with [28] who reported moisture content of 3.34-4.06% respectively. Carbohydrate content decreased with increased substitution of *acha* and sprouted soybeans flour 71.19 % to 66.38 %. There was significant difference ($p>0.05$) between the carbohydrates content of the cookies samples, Reduction in carbohydrate content of the cookies was observed, when the proportion of *acha* and sprouted soybeans flour in the formulation was subtituted. The reason of reduction in carbohydrate content of the cookie could be an increasing in protein, moisture, fat, ash and fiber content of the cookies as the proportion of *acha* flour in the formulation was increased at constant sprouted soybean substitution which leads a reduction in carbohydrate content since carbohydrate is calculated by difference. A similar reduction in carbohydrate content was also reported by [30] in their study of blending wheat flour with residue from king palm processing which contains a higher fiber, ash and fat content than wheat flour.

Table 4: Physical Properties of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

Sample Code (WASSF)	**Weight (g)**	**Diameter (mm)**	**Thickness (mm)**	**Spread ratio**
100:0:0	$15.61^{a}\pm0.01$	$63.20^{a}\pm0.01$	$11.99^{a}\pm0.01$	$5.28^{a}\pm0.01$
60:30:10	$16.02^{b}\pm0.01$	$62.09^{b}\pm0.01$	$10.50^{b}\pm0.01$	$5.91^{b}\pm0.00$
50:40:10	$16.30^{c}\pm0.01$	$61.98^{c}\pm0.02$	$10.29^{c}\pm0.01$	$6.02^{bc}\pm0.00$
45:45:10	$16.71^{d}\pm0.02$	$61.88^{d}\pm0.04$	$10.21^{cd}\pm0.01$	$6.06^{c}\pm0.01$
40:50:10	$16.97^{e}\pm0.03$	$61.69^{e}\pm0.01$	$10.07^{d}\pm0.04$	$6.13^{cd}\pm0.02$
35:55:10	$17.11^{f}\pm0.01$	$61.59^{f}\pm0.01$	$9.88^{e}\pm0.18$	$6.24^{d}\pm0.11$
LSD	0.04	0.05	0.18	0.12

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

3.3 Physical Properties of Cookie samples from Wheat, Acha and Sprouted Soybeans Flour Blends

The result of the physical properties of the cookies from wheat, *acha* and sprouted soybeans flour blends is as presented in Table 4: The results shows significant different in weight, diameter, thickness and spread ratio 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 weight of the cookies ranged from 15.61-1697g, diameter ranged from 61.59-63.20 mm, 9.88-11.99 mm and 5.28-6.24 respectively. The weight of the cookies samples increased as a result of the increase level of *acha* and soybean flour substitution, there was significant difference ($p>0.05$) between the various cookies samples. The findings were in contrary to the observation of some researchers who reported significant reduction in the weight of cookies produced from soya bean supplemented with wheat flour [15], cowpea-wheat [20], millet-sesame flour [32], bambara groundnut- maize flour [33] respectively.

There was a significant difference (p<0.05) between the value obtained for the cookie diameter supplemented with *acha* and sprouted soybean flour. As the proportion of *acha* flour increased in the formulation, a decreased in the average cookie diameter was observed. The thickness of the cookies was found to be significantly influenced both by blend proportion and baking temperature (p>0.05). However a decreased in the average thickness of the cookies was observed as the proportion of *acha* flour was increased in the formulation with constant sprouted soybean flour. The control (100% wheat) cookie showed a larger thickness (11.99mm) as compared to the other blend proportion. A similar decreased in the average cookie thickness was also reported for cookie prepared with Wheat and sweet potato flour [34], and wheat and residue from king palm processing [30]. The average spread ratio of the cookies showed significantly decreased as the proportion of *acha* flour was increased in the formulation at constant percentage of sprouted soybean flour. The cookie which was made from 100% wheat flour spread larger as compared to the blend proportion. According to [30] the spread ratio of cookies is strongly correlated to the water absorption capacities of flour.

Table 5: Sensory Attributes of the Cookies from Wheat, Acha and Sprouted Soybeans Flour Blends

Sample Code (WASSF)	**Appearance**	**Taste**	**Texture**	**Aroma**	**Overall acceptability**
100:0:0	$7.90^{a}\pm0.97$	$7.35^{a}\pm1.09$	$7.70^{a}\pm1.03$	$6.95^{a}\pm0.94$	$7.55^{a}\pm1.05$
60:30:10	$7.35^{ab}\pm1.14$	$7.30^{a}\pm1.08$	$7.00^{b}\pm0.97$	$6.55^{ab}\pm0.94$	$7.40^{a}\pm1.05$
50:40:10	$6.80^{bc}\pm1.24$	$7.15^{a}\pm1.04$	$6.70^{b}\pm0.98$	$6.50^{ab}\pm0.95$	$7.30^{a}\pm1.17$
45:45:10	$6.75^{bc}\pm1.02$	$7.25^{a}\pm1.07$	$6.55^{b}\pm1.15$	$6.40^{ab}\pm0.82$	$7.10^{a}\pm1.29$
40:50:10	$6.45^{c}\pm1.23$	$7.10^{a}\pm1.17$	$6.30^{b}\pm1.22$	$6.30^{b}\pm1.03$	$7.10^{a}\pm1.29$
35:55:10	$6.45^{c}\pm1.19$	$7.05^{a}\pm1.19$	$6.45^{b}\pm1.19$	$6.15^{b}\pm0.93$	$7.05^{a}\pm1.32$
LSD	0.71	0.69	0.69	0.59	0.75

Means in same column with same superscript are not significantly (p>0.05) different

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

3.4 Sensory Attributes of the Cookie samples from Wheat, Acha and Sprouted Soybeans Flour Blends

The result of the sensory attributes of the cookies from wheat, *acha* and sprouted soybeans flour blends is as presented in Table 5: The results showed significant difference in appearance, texture and aroma at (p<0.05) with no significant difference in taste and overall acceptability 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 cookies appearance ranged from 6.45-7.90, taste ranged from 7.05-7.35, texture ranged from 6.30-7.70, aroma ranged from 6.15-6.95 and overall acceptability ranged from 7.05-7.55 respectively. The brown appearance observed from the cookies samples resulting from Maillard reaction which always associated with baked foods. There were significant (p<0.05) difference among the sample means for all appearance scores. An increase in the substitution level of *acha* and sprouted soybean flour resulted in a decrease in appearance scores. Cookie produced from samples 40:50:10 and 35:55:10 scored least 6.45 in terms of appearance while the control (100 % wheat flour) cookies had the highest score of 7.90 for appearance. The scores for the appearance decreased with increase in the amount of *acha* flour in the blend, and substitution with 10% constant sprouted soybeans flour also contributed to the decrease in the appearance. The means scores for taste of cookies ranged from 7.05-7.35, there were no significant (p>0.05) deference among the cookie the samples. The scores for texture of the cookies samples were not significantly different (p>0.05) from each other, but significantly different from sample 100:0:0 (100% wheat flour), sample 60:30:10 (WASSF) had the next highest rating to the sample from sample 100:0:0. Aroma is another attribute that influences the acceptance of baked food products even before they are tasted. Substitution of wheat flour with either *acha* flour or sprouted soybeans flour at different levels significantly (p<0.05) affect the sensory score of aroma. The highest score of 6.95 in aroma was observed

in sample 100:0:0, while sample 35:55:10 scored the least 6.15. The findings were in close agreement with the findings of [5], who studied the effect of soybeans flour on the functional properties and the potential of soybean and cassava flour blends in cookies production.
The Aroma, appearance, texture and taste indeed influence the overall acceptability of the cookies samples. There was no significant ($p \leq 0.05$) difference between control sample and the other samples in terms of the overall acceptability. The control sample had the highest score of approximately 7.55 and sample35:55:10 had the lowest score of approximately 7.05. The final sensory analysis conducted by the panelist was the overall acceptability of the cookie. The overall acceptability of the cookie was significantly influence by the blend proportion ($p < 0.05$).

CONCLUSION

This study was able to develop composite flour from *acha* and sprouted soybeans for cookies production. The functional properties and proximate composition were elucidated. Acceptable cookies were produced from wheat, *acha* and sprouted soybean flour blends with the 60:30:10 been the most acceptable followed by the 50:40:10 level of supplementation.

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