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Full Length Research

Proximate composition and organoleptic characteristics of sausage rolls made from cocoyam and wheat flour enriched with soybean flour

Peter-Ikechukwu, A. I.[1], Ogbuagu J. C.[1], Osuji, C. M.[1], Ihediohamma, N. C.[1], Okafor, D. C.[1]* and Chukwu, M. N.[2]

[1]Department of Food Science and Technology, Federal University of Technology, Owerri. P. M. B. 1526, Owerri, Imo State, Nigeria.
[2]Department of Food Technology, Abia State Polytechnic, Aba, Abia State, Nigeria.

*Corresponding author. Email: okafordamaris@gmail.com

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ABSTRACT: Proximate composition and organoleptic properties of sausage rolls made from cocoyam and wheat flour enriched with soybean flour were studied. Cocoyam cormels and soybean were processed into flour, which were later used to formulate composite flour blends, with wheat flour in the ratio of: 90:10:0 (control 1), 80:10:10, 70:10:20, 60:10:30, 50:10:40, respectively, while 0:10:90 served as control 2. Each blend was used to produce sausage roll. The energy value of the flour blends was determined. Sensory qualities of the sausage rolls were also evaluated by 20-member panelists. The result of proximate composition of flour blends samples showed that moisture ranged from 6.00 to 11.20%. There were significant differences ($p \leq 0.05$) in protein, crude fat, crude fiber, ash, carbohydrate, and energy value among the samples. The addition of cocoyam and soybean flour increased protein, fat, crude fiber, carbohydrate and the energy value of the samples. The result of the sensory evaluation of the sausage rolls showed that CSW4 (50 cocoyam-10 soybean-40 wheat) was significantly different ($p \leq 0.05$) in appearance, color, taste and was preferred over others.

Keywords: Blends, cocoyam, composite flour, formulation, soybean, sausage roll, wheat.

INTRODUCTION

Sausage roll in the modern sense of meat, surrounded by rolled pastry, appears to have been conceived at the beginning of the 19th century in France. Sausage rolls are popular and widely consumed all over the world by people of all ages. They are traditionally made from wheat, a cereal, which is cultivated in many parts of the world. Wheat is imported by countries with unfavorable climatic conditions (Aziah et al., 2009). Hence, such importing countries spend a lot of foreign exchange on importation of wheat. Ndife et al. (2011; 2013) reported that the growth of wheat crops could be affected by natural disasters such as hurricane, flood etc which will in turn affect the yield and price of wheat.

Composite flour can be defined as a mixture of different ratios of non-wheat flours obtained from roots and tubers, cereals, legumes, etc., with or without the addition of wheat flour (Okpala and Okoli 2011). Composite flour is considered advantageous in developing countries as it reduces the importation of wheat flour and encourages the use of locally grown crops as flour (Hugo et al., 2000). Aziah and Komathi (2009) reported that there is an increase in the substitution for wheat flour, with local raw materials as a result of a growing market for confectioneries. Nigeria has not been able to produce wheat in commercial quantities because of climatic and soil conditions. Consequently, nearly all the wheat flour used for snacks and other products are imported. However, efforts are being made to partially replace wheat flour with non-wheat flours. This will possibly increase the utilization of indigenous crops cultivated in Nigeria as well as contribute to low cost of bakery products (Ayo and Gaffa, 2002).

Composite flour technology is important because of the advantage of reducing the huge amount of money spent on wheat flour importation, coupled with the prospects of the utilization of underutilized crops (Ajatta et al., 2016). Incorporation of cassava starch flour as composite in breadfruit influences the functional, proximate and rheological properties of blends used in confectionary production (Akanbi et al., 2009).

Wheat is the most desired cereal for the production of confectionary product due to its high gluten content. The high gluten content in wheat contributes greatly to dough sponginess and elasticity (Spiekermann, 2006). The increasing demands for wheat, as a result of increasing populations, urbanization and changing food habits (Olaoye, 2006) especially in the developing countries, has led to increased importation (Giami et al., 2004). Hence, wheat consuming countries located in tropical regions, which mostly are developing nations, rely on countries located in temperate regions for wheat importation (Elijah, 2014). The dependence on the use of wheat flour is a major constraint in biscuit production. Huge sums of money are involved in wheat importation: in 2010 alone, Nigeria spent ₦635 billion ($4.2 billion) on the importation of wheat (Momoh, 2011). It is therefore of economic importance if wheat importation is reduced by substitution with other local sources of flour for baking (Oyeku et al., 2008).

Soybean (*Glycine max*) is a leguminous plant widely grown for its edible bean which has numerous uses (Liu, 2000). It is the only plant source that provides all the essential amino acid (Ihekoronye and Ngody 1985; Ojinnaka and Nnorom, 2015), phytosterols, B vitamins and minerals (calcium, iron, phosphorus) (Ojinnaka and Nnorom, 2015). Soybean is one of the richest and cheapest sources of plant protein that can be used to improve the diet of millions of people (Liu, 2000). Soyabean (*Glycine max)* is an excellent source of protein (35 to 40%) and the seed is reported as the richest in food value of all plant foods consumed in the world (Kure et al., 1998).

Cocoyam (*Xanthosoma sagittifolium* and *Colocasia esculenta*) is an edible root crop grown in the tropics of which Nigeria is a major producer. It belongs to the *Araceae* family (Okpala et al., 2013). Cocoyam contributes significant portion of the carbohydrate content of the diet in many regions in developing countries and provide edible starchy storage corms or comels (Kabuo et al., 2018). Cocoyam has nutritional advantages over other root and tuber crops (Ojinnaka and Nnorom, 2015). It has more crude protein than other root and tuber crops and its starch is highly digestible because of the small size of the starch granules, its contents of calcium, phosphorus, vitamin A and B- vitamins are reasonable (Kabuo et al., 2018). All these are lost to nutrition because of low production and underutilization. Ammar et al. (2009) noted that edible aroid flours could be advantageous in the preparation of myriad products in the food development industry since it could be used in dehydrated soup formulation, baking goods, formulation of baby food, snacks and breakfast products. The flour from cocoyam has been used in baking of products as it has been reported that cocoyam has fine starch granule, which improves binding and reduces breakage of snack products (Huang, 2005). Recent studies show that cocoyam starch can be incorporated in the development of weaning food which is easily digestible and accessible to low income earners in developing countries (Watanabe, 2002; Ojinnaka et al., 2009). Recent works (Owuamanam et al., 2010; Nwanekezi et al., 2010: Nurtama and Lin, 2010) have studied the moisture sorption isotherm of cocoyam flour, which according to Idlimam et al. (2008) are important to improve the conditions of several processes such as dehydration, packaging or storage (Obiegbuna et al., 2014).

However, the utilization options of cocoyam are mainly limited to direct consumption as whole and boiled tuber or pounded into *fufu* and used as a soup thickener, thus making it an underutilized tuber and an insufficiently studied crop (Watanabe, 2002). The utilization and market options of cocoyam are very limited due to limited processing and utilization options. They are currently found in abandoned farmlands and in disposal dumps. The major limiting factor in the utilization of cocoyam is the presence of oxalates which impart an acrid taste or cause irritation in the throat and mouth when foods prepared from it are eaten and interfere with bioavailability of calcium (Sefa-Dedeh and Agir-Sackey, 2004), high rate of post-harvest losses and the lack of scientific attention (Mbofung et al., 2006).

As there is a growing interest in the production of flours from locally available grains that can be used as substitutes for wheat in baked goods, this study was undertaken to determine the proximate composition and organoleptic properties of sausage rolls formulated from cocoyam, soybean and wheat flour blends. Cocoyam is not utilized properly. It is mostly used as thickener in soup and few indigenous recipes. Therefore, its conversion into flour could be used efficiently in baking technology.

It is expected that the success of the present study will serve as a basis for the production of dietary sausage rolls with improved nutrition. The use of cocoyam as a composite flour will go a long way to improve its utilization and add value to it, as well as creating awareness about the nutritional qualities. The use of cocoyam will also reduce dependency on wheat flour, thereby reducing foreign exchange used in importing wheat. In addition, there will be reduction in the risk of heart disease, some types of cancers and severity of celiac disease caused by gluten (Wünschea et al., 2018) by way of substitution with non-wheat flour in pastries. It is also a product development.

MATERIALS AND METHODS

Material collection

Cocoyam (*Xanthosoma sagittifolium*) cultivar, *Ede uhie*,

Plate 1. Oven-dry slices of Cocoyam (*Xanthosoma sagittifolium*) *Ede Uhie.*

Plate 2. Cocoyam flour (*Ede Uhie*).

soybeans (*Glycine max*) and wheat flour were purchased from Eke-ukwu market, Owerri, Imo State Nigeria. All other reagents used were of analytical grade.

Processing of cocoyam into flour

Cocoyam comels were processed into flour using the method described by Oti and Akobundu (2007). About 1 kg cocoyam cornels, cultivar *Ede Uhie* were peeled, sliced and washed with water. The slices were blanched at 75°C for 15 minutes in portable water. The blanched slices (Plate 1) were dried (Genlab Moisture Extraction Oven: Model-MINO/50) at 60°C for 9 hours and milled to obtain flour which was subsequently sieved through 250 μm aperture to yield flour of fine texture (Figure 1 and Plate 2).

Preparation of soybean flour

Soy flour was prepared according to the method described by Ndife et al. (2011) and Oluwamukomi et al. (2005). The soybeans (1 kg) were thoroughly cleaned to remove dirt and other extraneous materials such as stones and sticks. It was then washed, boiled in water at 100°C for 30 minutes. It was dehulled manually, oven-dried at 55°C for

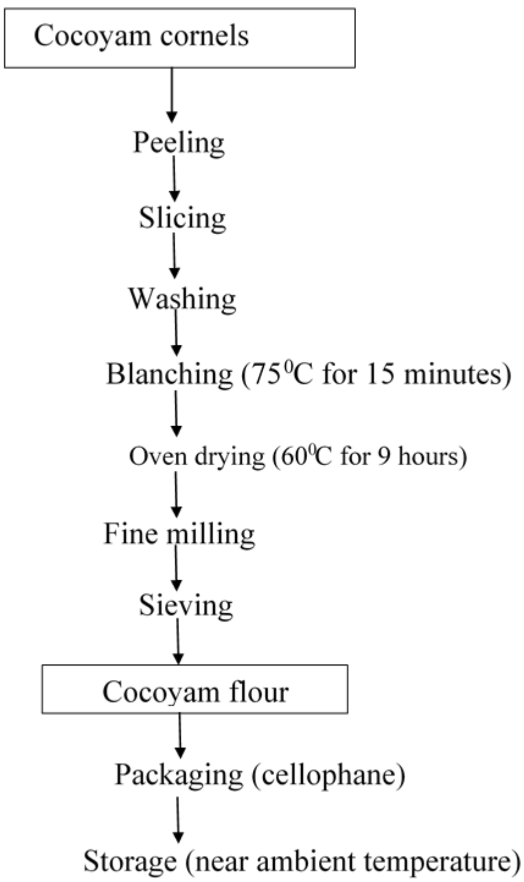

Figure 1. Flow diagram of the preparation of cocoyam flour.

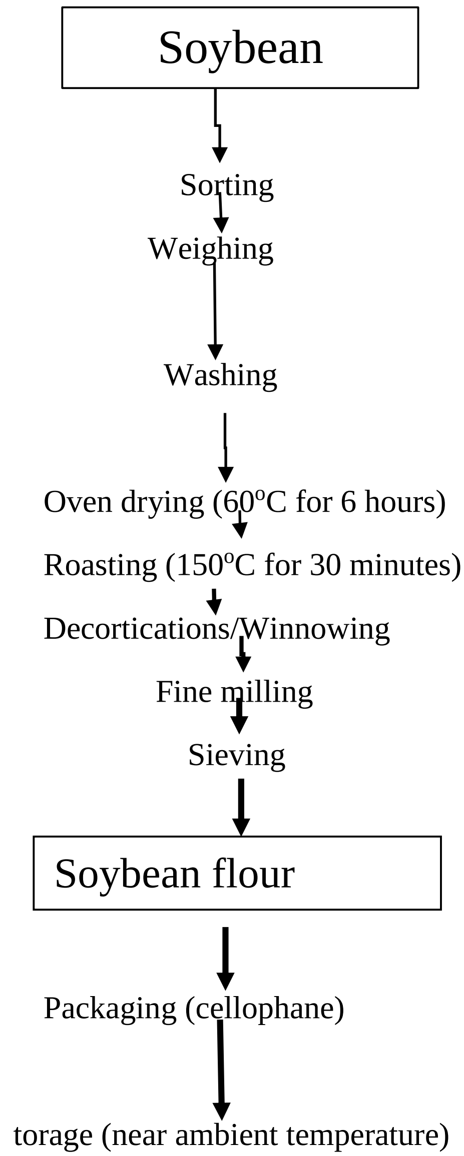

Figure 2. Flow diagram of the preparation of Soybean flour.

16 hours. Later, it was winnowed and milled into fine flour using hammer mill (Model EU 5000 D) and sieved through 250 µm aperture sieve (Ojinnaka and Nnorom, 2015). The flour was packed and sealed in polyethylene bags until further use (Figure 2 and Plate 3).

Formulation of flour blend

Six blends of composite flour were prepared by mixing cocoyam flour, soybean flour and wheat flour in the percentage ratio of 90:10:0, 80:10:10, 70:10:20, 60:10:30, 50:10:40 and 0:10:90 respectively. (90:10:0) and (0:10:90) served as control (Table 1).

Sausage roll preparation

The formulated flour blend samples were used in producing sausage roll respectively. The ingredients used for the production and their right proportions are shown in Table 2. Sausage rolls were prepared according to the method of Nigerian Sausage roll preparation (www.nigerianfoodtv.com) with some modifications in the recipe. The meat filling was first prepared. The boneless beef was ground and seasonings (salt, nutmeg, mixed spices and stock cube) were thoroughly mixed using a Binatone blender (Model N0: BLG-650). The mixture was set aside. The dry ingredients (flour, baking powder, salt and sugar) were thoroughly mixed in a bowl by hand. The margarine was added in scoops and rubbed into the dry mixture till it formed crumbs. Thereafter cold water was added in bits till non-sticky smooth dough was formed. The dough was kneaded for 5 minutes. The dough was cut out in a rectangular shape, rolled to a flat size. The spiced beef placed on the edges of the dough and folded into a cylindrical shape. Whisked egg was brushed on the dough and they were placed on oil-greased baking trays, leaving 25 mm spaces in between and were baked at 170ºC for 35

Plate 3. Soybean flour.

Table 1. Formulation of Flour Blends.

Blend	Cocoyam Flour, C (%)	Soybean Flour, S (%)	Wheat flour, W (%)
CS0	90	10	0
CSW1	80	10	10
CSW2	70	10	20
CSW3	60	10	30
CSW4	50	10	40
0SW5	0	10	90

Table 2. Ingredients for Sausage Roll Preparation.

Ingredient	Proportion
Flour	100g
Baking Powder	2.15g
Margarine	100g
Salt	0.76g
Sugar	1.90g
Beef	100g
Nutmeg	0.76g
Mixed spices	0.76g
Stock cube	0.76g
Egg	1 medium size
Cold Water	600 ml

minutes in the baking oven. Following baking, the sausage roll was cooled at ambient temperature (Plate 4), packaged in polyethylene chin-chin bags and stored at near ambient temperature (28 ± 2^{o}C) prior to subsequent proximate analysis and sensory evaluation. The procedure is shown in Figure 3.

Proximate analysis

The proximate analysis of the flour samples was carried out using standard methods of Association of Official Analytical Chemists (AOAC, 2000).

Plate 4. Sausage roll (CSW4) (50%cocoyam-10%soybean-40%wheatflour).

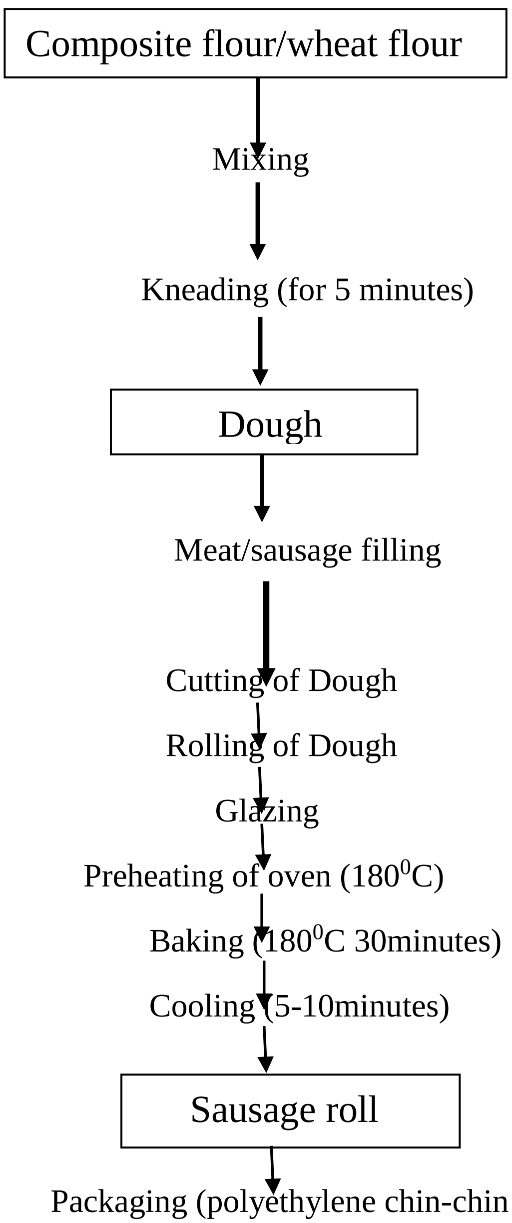

Figure 3. Flow diagram of production of cocoyam-soybean-wheat flour sausage roll.

Determination of energy value

The energy value was determined by Atwater factors (Osborne and Voogt, 1978).

Sensory evaluation

Twelve hours after the preparation of the sausage rolls, sensory evaluation of the sausage rolls were determined using 20-member panelist consisting of staff and students of the Department of Food Science and Technology, Federal University of Technology, Owerri, Nigeria. The panelists were either regular or occasionally consumers of sausage rolls and were not allergic to any food. Sausage roll samples prepared from each flour blend were presented in coded white microwavable plastic container. The order of presentation of the samples to the panelists was randomized (Kabuo et al., 2018). The panelists were instructed to evaluate the coded samples for appearance, color, taste, texture, aroma, mouthfeel and overall acceptability. A 9-point hedonic scale quality analysis as described by Larmond (1997) was used with 1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely. The panelists were instructed to rinse their mouths with water after tasting every sample and not to make comments during evaluation to prevent influencing other panelists. They were also asked to comment freely on samples on the questionnaires given to them.

Statistical analysis

Triplicate data obtained were subjected to statistical analysis using SPSS software of version 21. Mean values were determined and ANOVA was done as well as Fisher's Least Significant Difference (Pallant, 2004) was used to determine for the separation of the means at ($p \leq 0.05$).

RESULTS AND DISCUSION

Proximate composition

The result for proximate composition of flour blends are shown in Table 3.

Moisture content

The moisture content of 0SW (90% wheat flour-10% soybean) was the highest (11.20%) while the rest of the samples were below 11.20% and CS0 had the least value (5.45%). The moisture content of the flour samples was significantly different (p≤0.05). The percentage moisture content reduced as cocoyam substitution increased and is below the moisture level (10%) which is recommended for safe keeping of flour samples. This implies that the flour samples have good shelf-life. Moisture content of any food sample is of significant to the shelf life, packaging and general acceptability (Okaka and Okaka, 2001; Obiegbuna et al., 2014).

Protein content

CSW1 (80% cocoyam-10% soybean-10% wheat flour) had the highest protein content (38.50%) while 0SW (90% wheat flour-10% soybean flour) had the least (28.90%) value. There were significant differences (p≤0.05) among the flour samples. Protein content increased with increase in cocoyam substitution. The high protein content of cocoyam was in accordance with that reported by Braide and Nwaoguikpe (2011). The values (28.90 to 38.50%) reported in this work was much higher than (7.4 to 8.9%) and (4.93 to 5.17%) reported for cocoyam by Amandikwa and Chinyere (2012) and Ogunlakin et al. (2012) respectively. This shows that the flour samples in this study had improved protein value. Proteins are the building blocks and foods that are rich in protein are known to reduce protein-energy malnutrition.

Crude fat

The crude fat content ranged from 16.55% to 24.60%. Fat content of the flour samples were found to be highest in CWS1 (24.60%) and least in 0SW (16.55%). There were significant differences (p≤0.05) in fat content among the samples. The mechanical properties of baked foods are largely dependent on the fat composition (O'brien, 2003). Fat gives flavor and soft texture to food, nevertheless, high level of fat are undesirable in food products because they could lead to rancidity in foods.

Crude fiber

Crude fiber of the flour samples was found to be highest in CSW1 (7.33%) while 0SW had the least (3.60%). Significant difference (p≤0.05) occurred among the samples. Observation indicated an increase in crude fiber content with higher cocoyam substitution. This could be attributed to the fiber content of cocoyam according to a literature review on cocoyam (Ojinnaka and Nnorom, 2015). The fiber content of the flour samples was within the recommended range of not more than 5 g dietary fiber/100g of dry matter (FAO, 2004). According to Ekwe et al. (2009) and Chugh et al. (2013), consumption of food rich in dietary fiber reduces the risk of diabetes mellitus, cardiovascular diseases, constipation, appendicitis, hemorrhoids and colon cancer.

Ash content

The ash content of the flour samples was within the range of 1.30% to 3.10%. CS0 had the highest (3.10%) while 0SW had the least (1.30%). There was significant difference (p≤0.05) among the samples. The higher value of the ash content could be attributed to the addition of cocoyam which contains minerals. Ash content represents the total mineral content of any food material (O'brien, 2003).

Carbohydrate

The carbohydrate content of the flour samples ranged from 21.80 to 38.61%. There was significant difference (p≤0.05) among the samples. CWS1 had the highest (38.61%) while 0SW had the least (21.80%). There was increase in the carbohydrate content as the substitution with cocoyam increased. This could be attributed to the higher carbohydrate content of cocoyam. Enwere (1998) reported that in all the solid nutrients in roots and tubers, carbohydrates predominate. The high carbohydrate content indicates that cocoyam is an excellent source of energy.

Energy value

The results of the energy value of the flour samples are shown in Table 3. The energy value for the flour sample is ranged from 1750 to 1931kJ/100g. CSW1 had the highest value (1931 kJ/100g) while 0SW had the least (1750 kJ/100g). This may be attributed to the fact that cocoyam is a good source of carbohydrate, predominantly starch and are consumed as energy yielding food. The calories from cocoyam come from complex carbohydrates known as amylose and amylopectin (FAO, 2004). There were significant differences (p≤0.05) among the samples.

Organoleptic properties of sausage rolls

Table 4 shows the organoleptic properties of sausage rolls produced from the flour samples.

Appearance

The appearance of the sausage roll samples ranged from

Table 3. Mean values of proximate composition of flour samples.

Sample	Ash (%)	MC (%)	C. Fat (%)	C. Fiber (%)	Protein (%)	CHO (%)	Energy (kJ/100g)
CS0	3.10±0.00[a]	6.00±0.02[e]	23.00±0.58[b]	7.00±0.00[a]	37.50±0.00[b]	35.90±0.02[b]	1920.00±0.00[a]
CSW1	2.60±0.00[b]	5.45±0.02[f]	24.60±0.01[a]	7.33±0.53[a]	38.50±0.01[a]	38.61±0.07[a]	1931.00±0.01[a]
CSW2	2.60 ± 0.01[b]	6.91 ± 0.03[d]	20.40±0.05[c]	6.45 ± 0.51[b]	35.00 ± 0.02[c]	30.20 ± 0.01[c]	1880.00 ± 0.35[c]
CSW3	2.10 ± 0.01[d]	7.00 ± 0.01[c]	20.00 ±0.11[c]	6.22 ± 0.01[b]	34.40 ± 0.06[d]	28.90 ± 0.02[d]	1835.00 ±0.35[d]
CSW4	2.20 ± 0.01[c]	7.40 ± 0.01[b]	18.20± 0.20[d]	6.00 ± 0.01[b]	30.50 ± 0.03[e]	23.50 ± 0.11[e]	1790.00 ± 0.21[e]
0SW	1.30 ± 0.02[e]	11.20 ± 0.50[a]	16.55± 0.03[e]	3.60 ± 0.07[c]	28.90 ± 0.04[f]	21.80 ± 0.00[e]	1750.00 ± 0.02[f]
LSD	0.09	0.07	1.50	0.53	0.53	2.00	3.00

Mean ± Standard deviation of triplicate. Means with the same superscript within a column are not significantly different ($p \leq 0.05$)
KEY: CS0: Cocoyam-soybean flour (90:10:0) (control 1), CSW1: Cocoyam-soybean-wheat flour (80:10:10), CSW2: Cocoyam-soybean-wheat flour (70:10:20), CSW3: Cocoyam-soybean-wheat flour (60:10:30), CSW4: Cocoyam-soybean-wheat flour (50:10:40), 0SW: Soybean-wheat flour (10:90) (control 2), MC = Moisture content, CF = Crude fat, Cfiber = Crude fiber, CHO = Carbohydrate.

Table 4. Mean values of organoleptic properties of sausage roll samples.

Sample	Appearance	Colour	Taste	Texture	Mouthfeel	Aroma	Overall Acceptability
CS0	7.00 ± 0.00[b]	7.33 ± 1.15[b]	4.67 ± 1.53[b]	4.33 ± 1.53[b]	4.00 ± 1.73[a]	3.33 ± 0.58[b]	4.00 ± 0.00[c]
CSW1	7.33 ± 1.15[b]	6.67 ± 0.58[b]	5.67 ± 1.58[ab]	7.67± 0.58[a]	7.00 ± 3.46[a]	5.67 ± 2.31[ab]	6.33 ± 1.15[b]
CSW2	7.33 ± 1.15[b]	6.67 ± 0.58[b]	6.33 ± 0.58[ab]	7.67 ± 0.58[a]	7.33 ± 2.59[a]	6.00 ± 1.73[ab]	6.67 ± 0.58[b]
CSW3	7.33 ± 0.58[b]	7.33 ± 1.15[b]	6.33 ± 0.58[ab]	7.00 ± 1.73[ab]	6.67 ± 2.04[a]	6.67 ± 1.53[a]	8.00 ± 0.00[a]
CSW4	8.67 ± 0.58[a]	8.67 ± 0.58[a]	7.33 ± 1.16[a]	6.33 ± 1.16[ab]	5.33 ± 1.16[a]	7.00 ± 1.00[a]	8.67 ± 0.58[a]
0SW	6.33 ± 0.58[b]	7.00 ± 0.00[b]	5.67 ± 0.58[ab]	4.67 ± 2.08[b]	6.33 ± 0.58[a]	4.33 ± 2.08[ab]	4.67 ± 0.58[c]
LSD	1.3	1.31	2.59	2.62	4.09	3.31	1.29

Mean ± Standard deviation of triplicate. Means with the same superscript within a column are not significantly different ($p \leq 0.05$)
KEYS: CS0: Cocoyam-soybean flour (90:10) (control 1), CSW1: Cocoyam-soybean-wheat flour (80:10:10), CSW2: Cocoyam-soybean-wheat flour (70:10:20), CSW3: Cocoyam-soybean-wheat flour (60:10:30), CSW4: Cocoyam-soybean-wheat flour (50:10:40), 0SW: Soybean-wheat flour (10:90) (control 2).

6.33 to 8.67. CSW4 (50% cocoyam-10% soybean-40% wheatflour) had the highest value (8.67; i.e., like extremely) while 0SW (10% soybean-90% wheat) had the least (6.33). This shows that CSW4 was more appealing and palatable to the panelists than other sausage roll samples and was most preferred for color, taste and aroma. There was significant difference ($P<0.05$) among the sample (Ndife et al., 2013).

Colour

The color of the samples ranged from 6.67 to 8.67. CSW4 had the highest color value while CSW1 (80% cocoyam-10% soybean-10% wheat flour) and CSW2 (70% cocoyam-10% soybean-20% wheat flour) had the least color (6.67; i.e., like slightly). This could be attributed to color of the cocoyam flour since the least color was for higher cocoyam substitution. The color of the sausage roll samples were not significantly different ($p>0.05$). Color is an important sensory attribute of any food because of its influence on acceptability. The brown color of the sausage rolls was also due to Millard reaction which occurs as a result of the interaction between protein and sugar at high temperature during baking (Ubbor and Akobundu, 2009).

Taste

The taste of the samples ranged from 4.67 to 7.33. CSW4 (7.33; i.e., like moderately) had the highest taste value while CS0 (4.67; i.e., neither like nor dislike) had the least value. The taste values for samples were significantly different (P<0.05). The result showed that sausage roll sample made from (50% cocoyam-10% soybean-40% wheatflour) had the best taste and was more preferred by the panelists.

Texture and Mouth-feel

The texture and mouth-feel of the samples were within the range of 4.33 to 7.67 and 4.00 to 7.33 respectively. The samples were significantly different (p<0.05) in their texture while there was no significant difference within the samples in mouth-feel. CSW1 and CSW2 had the highest value (7.67; i.e., like very much) while CS0 (90% cocoyam-10% soybeanflour) had the least value (4.33; i.e., dislike slightly) of texture. The poor texture of CS0 could be attributed to the fact that cocoyam has zero percent (0%) gluten (Emmanuel-Ikpeme et al., 2007). Hence, Okaka (2005) stated that gluten is a special protein that consists of glaidin and glutenin which are responsible for the elasticity and good dough formation during baking when water is added. Wheat is the crop that contains a substantial amount of gluten. CS0 had the least value for mouthfeel (4.00; i.e., dislike slightly) while CSW2 (70% cocoyam-10% soybean-20% wheat flour) had the highest mouthfeel.

Aroma

The values for the aroma ranged from 3.33 to 7.00. CSW4 (50% cocoyam-10% soybean-40% wheat flour) had the highest value (7.00; i.e., like moderately) while CS0 had the least value (3.33; i.e., dislike moderately). There was significantly different (P<0.05) within the samples.

Overall acceptability

The overall acceptability of the samples ranged from 4.00 to 8.67. CSW4 had the highest value (8.00 i.e., like very much) while CS0 had the least value (4.00 i.e., dislike slightly). The overall acceptability of samples were not significantly different (p<0.05). It was observed that as cocoyam substitution decreased the overall acceptability of the sausage roll samples increased. CSW4 had the highest value for appearance, color, taste and aroma and these resulted to CSW4 being most preferred by the panelist.

Conclusion

The formulation and use of composite flours in baking is gaining popularity in food industries. It is one of the various means of fighting malnutrition resulting from nutrient deficiencies. The proximate compositions of the cocoyam-wheat composite flour incorporated with soybean could augment for protein; hence, these samples could go a long way in solving protein-energy malnutrition problems. From the result of sensory evaluation, sausage roll from composite flour (50% cocoyam, 10% soybean and 40% wheat flour: CSW4) may be recommended for sausage roll industries due to its high overall acceptability showing that it would have high market value. Sausage roll sample (CSW4), from composite flour (50% cocoyam, 10% soybean and 40% wheat) could be recommended for diabetes, heart disease, obesity and weight management due to its high fiber content.

Furthermore, this study has created the utilization of cocoyam, so as to add value to it, and helps in reducing the dependency on wheat flour. This will go a long way to conserve our economy by saving the huge foreign reserve used for wheat importation. Our indigenous tuber crop (cocoyam) will no longer be wasted in terms of excess. Again, this technology can simply be used in homes to create variety in meals and prevent monotony in feeding wastes also.

Recommendations

The following recommendations are necessary based on the results obtained:

1. Further studies should be done to improve the color and texture of the sausage roll to make it more appealing and palatable.
2. Shelf-life, packaging and storage studies should be done because no preservative was added to the sausage roll and they spoilt within few days of production.
3. Farmers of cocoyam will be encouraged as they will be making more sales since a conversion of product from their produce has been developed.
4. Globally, convenience is the main focus, producing a snack with local raw material which can compete with the conventional, will be a welcome development.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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