PRODUCTION AND QUALITY EVALUATION OF COOKIES WITH BLENDS OF COCOYAM (*XANTHOSOMA SAGITIFOLLIUM*) AND WHEAT FLOUR

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ABSTRACT:

In this study, cookies were produced in substitution of wheat flour with cocoyam flour at 100:0, 90:10, 85:15, 80:20, 50:50 levels of substation. The proximate composition of control cookies sample A (100:0) had 6.7a $\pm$ 0.03, moisture content, 0.43 $\pm$ 0.30 crude protein content 28.02$\pm$ 0.13, fat content, 0.43 $\pm$ 0.01, crude fibre content 2.53$\pm$ 0.01, ash content, 56.32 $\pm$ 0.48, and carbohydrate 57.89 $\pm$ 1.70. The 15% dilution level sample C (85:15) had 5.94. 0.14 moisture content, 5.72 $\pm$ 0.10, protein content, 26.31 $\pm$ 0.42 fat content, 0.91 $\pm$ 0.04 fibre content, 1.86 $\pm$ 0.02 ash content and carbohydrate content 57.89 $\pm$ 1.70. Sensory evaluations were carried out on the biscuit samples by 12 semi trained panelist using 7 point hedonic scales to evaluate the taste, aroma, crispness, appearance and overall acceptability. Sample A (100.0) (control) had the highest overall acceptability with the mean score 6.75 $\pm$ 0.45 was not significantly different with other samples at p<0.05. Therefore, addition of cocoyam by 20% will impair sensory quality of produced cookies and it is therefore recommended in this study.

KEYWORDS: Cocoyam Cookies, Wheat Flour Blends, Quality Evaluation, Cookie Production, Xanthosoma Sagitifollium

1.0 INTRODUCTION

Cookies are a small sweet cake, typically round, flat and crispy. The alternative name is called biscuit. It is commonly baked unit crisp or just long enough that they remain soft, but

some kinds of cookies are not baked at all. Cookies are made in a wide variety of styles using array ingredients. Cookies are nutritive snacks obtained from dough which is transformed into a digestible and more appetizing product through the application of heat in the oven (Namoda, 2002). The principal ingredient for cookies production is wheat with other ingredients as well as margarine shortening, sweeteners (Sugar), leaving agents, egg flavor and milk (Sanni and Eniola, 2004). It may be regarded as a form of confectionary dried to very low moisture content (Okaka, 1997). Cookies are used a breakfast in most countries especially Nigeria and it is also used as snacks. Children eat cookies very well and make it their daily eating habit, while adults eat cookies as an appetizer. The flour of cookies are typically milled from soft wheat, though there are different cookies for which special types of flours are demanded (Kent, 1975). Wheat flour used in baking of cookies is unique in its ability to interact with water and the addition of other ingredients such as fat, sugar and flavoring agent to form a strong cohesive. Nigeria greatly depend on the importation of three million tones of wheat annually from other countries for the production of cookies (Ihekoronye and Ngoddy, 1985) and this places a considerable burden on the foreign reserves of Nigeria's economy.

While cocoyam (XnathosomaSagittifillium) is a tuber that produces edible starchy tubers and vegetables which is highly appreciated by the local populations. Cocoyam has fine granular starch which has been reported to improve binding and reduce breakage of snack products (Huang, 2005). Some of the aforementioned crops are grown in Nigeria in large quantity but are underutilized.

This work is aimed at producing cookies from blend of wheat and cocoyam flour and evaluating the Nutritional Quality of Cookies produced.

1.1 JUSTIFICATION

The production of cookies from the blends of wheat and cocoyam flour is pertinent because it enhances the utilization of local crops as raw materials and improves the Nutritional quality of Cookies and it will also help to reduce the importation rate of wheat into the country.

2.0 LITERATURE REVIEW

2.1 DEFINITION AND HISTORY OF COOKIES

Cookies are defined as a variety of handheld, flour based sweet cake either crisp or usually with a golden brown crust (Alla in and Brain, 1982). Wheat Flour is usually used for cookies

and other bakery products and other ingredients such as margarine, sweeteners (sugar), leavening agents, egg, flavours and milk (Sanni and Eniola, 2004). The name cookies is derived from the Dutch word "Koekje" meaning "small or little cake "According to culinary historians, The First historic record of cookies was their use as test cakes. A small amount of cake batter was baked to test the oven temperature. The Italian identified cookies as "amoretti and Biscotti" and so on. Cookies are consumed in 95.2% of U.S households. American alone consumes over 2 million cookies a year or 300 cookies for each person annually. And the American Appetite for cookies continues to grow (Vodrey, 2001).

2.1.1 TYPES OF COOKIES

This are the major types of cookies; Bar cookies, Drop cookies, molded cookies, pressed cookies, refrigerated or icebox cookies, rolled cookies. They are classified based on the shape and proportion of the ingredient used in making them such as fat, sugar and eggs. And the method by which they are made. The higher the proportion of fat and eggs in the mixture, the richer the cookies will be (Orielly, 1993).

2.1.2 NUTRITIONAL VALUE OF COOKIES

Cookies come in so many different flavors that you likely have one that you enjoy a great deal and are general regarded as energy producing food. Cookies contains a great deal of calories by richness in fat, it is also an appetite suppressant. It has an advantage of which has a distinctive appeal. It adds variety to the diet, and a means of supplying both vitamin A and B. it has a good source of fat, protein, ash an carbohydrate (Benmon and Barford, 1983).

2.1.3 COOKIES FROM COMPOSITE FLOURS

The proximate composition of cookies made from composite flour is created to satisfy specific functional characteristics and nutrient composition compared with cookies made from 100% wheat flour (Dendy, 1992).

The aim of producing composite flour is to get a product that is better than the individual protein, ash, fiber, moisture, fat and carbohydrate content of cookies produced from blends of composite flour.

2.1.5 COOKIES QUALITY

Cookies quality is determined by width (W) and thickness, its color and shape, its good flavor and general appearance, its attractiveness with a good eye appeal (Benmon and Bamford, 1983)

The quality deserved in cookies relates to volume, color, texture, crispness, flavor and appearance (Terrell, 1979).

2.2 INGREDIENTS IN MAKING COOKIES AND THEIR FUNCTIONAL PROPERTIES

There are several baking ingredients in making cookies. The mandatory ones are Eggs, flour, sugar, fat, baking powder and other optional such as vanilla, nutmeg, milk etc. (Anyanwu, 2007).

The function of the ingredient is to present cookies in its attractive, palatable and digestible form (Kent, 1975).

FLOUR: Is the ingredient on which most baked products are based. Flour is made up of starch, protein, sugar and minerals. The protein decides what the end use of the flour will be.

FAT: fat coat gluten molecules so they cannot combine as easily, contributing to the finished product's tenderness. In some cases fat also contribute to the fluffiness of the final product. Fat also carry flavor and add to a tender mouth feel.

SUGAR: Sugar add sweetness, as well as contributes to the products browning which results from chemical interaction between sugars and protein and it is referred to as the browning reaction or the mallard reaction. Sugar holds moisture in the finished product. Sugar crystals cutting into solid fats like butter helps form the structure of the product by making small holes which act as a preservative.

EGG: Eggs are leaving agent and the yolks add fat for a tender and light structure. The yolks also acts an emulsifier for a smooth and even texture in the finished product. And the protein contribute to the structure of the baked goods.

WATER: Water helps carry flavoring throughout the product, form gluten bonds and reacts with the starch in protein for a strong but light: structure. Water also acts as steam during baking, acting as a leaving agent and contributing to the tenderness of the products.

LEAVING AGENTS: Baking soda and baking powder form carbon-dioxide that is held by fat pockets, gluten and starch which makes the baked product rise.

SALTS: Salt strengthens gluten and add flavor, salt enhance flavor. In some cases like bread making, salt helps moderate the effect of the yeast so the bread does not rise quickly.

COLOUR: It adds color to product in which they are used. Egg yolk adds yellow colour to baked product by the mallard reaction which may be caused by enzymatic oxidation of polyphenols and other compound.

2.3 WHEAT FLOUR

Wheat flour is a powder dame from grinding of wheat used for human consumption. After milling, 75% of the wheat grain is extracted. Most of the bran and germ are sieved away leaving mostly the endosperm. This result in loss of some vitamins and minerals as well as dietary fiber (Kulp and Ponte, 2000).

Wheat varieties are called "clean" "white" or "brown" or "hard" if they have high gluten content and they are called "soft" or "weak" flour if the gluten content is low. Hard flour or bread is high in gluten with 12% to 14% gluten content and has elastic toughness that holds its shape well once baked. Soft flour is comparatively low in gluten and so results in a finer crumbly texture (Chu, 2004).

Wheat flour by virtue of its protein (gluten) has long been established as the principal raw material for baking bread, cookies, and biscuit, cakes (Osiegbema and Onyia, 1999). The protein in wheat has a species property which when hydrated with water and mixed to a dough form a very hard mixture work known as "gluten" which helps in retaining the gas that is produced by fermentation (wariness and kent, 1957). Pastry or cookies flour is used for cookies making because it has slightly higher protein content than cake flour but lower than all purpose flour. Its protein content ranges between 9% and 10%. It is available as white flour, while wheat flour, or white flour with the germ retained but not the bran. It is suitable for cookies quick bread, muffins etc flour is shaken through a sieve to reduce the amount the lumps for cooking pastry (chu-2004).

2.4 CLASSES OF WHEAT FLOUR

We have two basic types of flour, the soft and hard wheat flour. They are based on their suitability for the production of bread, cookies cakes and biscuits.

HARD WHEAT FLOUR: This contains tenacious, elastic dough of good gas retaining properties and is capability of being baked into well risen shapely loaves and good texture. Its protein content is relatively high about 12% to 14%.

SOFT WHEAT FLOUR: This contains a relatively low protein (about 8.4%) and form soft, weak inelastic dough of poor gas retaining properties. They have relatively low water absorption capacity and yield dough of inferior quality. They are suitable for the production of cookies, cakes e.tc. (Marcraeetal, 1993).

2.5 PRODUCTION PROCESSES OF COOKIES MIXING PROCESS OF COOKIES

During the production of cookies, the mixing process should flow from one stage to the next to finish without interruption. The sugar and shortening are creamed well together, then the eggs and other liquids are added then scrapped down the sides of the mixing bowl and mixed slight. The other ingredients are added (dry), nuts, chips, extract (flavor). The flour is added and mixed to incorporate thoroughly and this is done one after the other to avoid curdling of the butter (Orielly, 1993). When the cookies dough mixture is dry, an egg yolk is added instead of water because water makes dough tough. The fat content of an egg yolk will keep dough tender and its emulsifying action will keep it moist after baking.

BAKING PROCESS OF COOKIES

The cocoyam is a well known food plant, which has a long history of cultivation. Its forms are an important source of starch. The leaf stalks can also be eaten; they can be cooked and eaten spinach. All parts of the raw cocoyam plant contain a toxic compound, calcium oxalate which must be destroyed by through cooking eating (Wilson. W, 2009).

Cocoyam is members of the aroid family, Araceae. Their extract origin is not clear but they may come from India or South East Asia (Wilson's, 2009). The plant is a herbaceous in nature and is capable of growing to a height of 2 meters. Edible cocoyam are known by several common name which include the "Taro or elephant's" Ear by the Westerners, "Keladi" in Malay or simply yam by Singaporeans. There are two types of edible cocoyam namely the Dasheen and Eddoe. That differs in terms of size and shape of the corms. The dasheen produces a large, barrel-shaped mother corm surrounded by several smaller cormels. The Eddoe on the other produces comparatively smaller mother corm than the dasheen and has numerous cormels around the mother corm. The dasheen is given the scientific name "Colocasia esculenta" var. Esculenta" while Eddoe's is colocasia esculenta varantiquorum. The species name "esculenta" is derived from the English word "esculent" which means edible (Wilson, 2009).

2.7 NUTRITIONAL COMPOSITION OF COCOYAM

Cocoyam is very rich in vitamin B_6 and magnesium, which helps control high blood pressure and protects the heart. It is also rich in dietary fiber and good for proper glucose metabolism. Popular amongst diabetics in Africa may be due to its content of loose carbohydrate in form of starch rather than sugar. Cocoyam flour made from desiccated and grounded cocoyam is very in loose starch, thus making it easily digestible, yet it is rich in fiber and protein. This

property lends cocoyam very desirable for those with sensitive bowel like irritable bowel syndrome, or those prone to gas or wind after meals (trapped wind), burning sensation in the throat and mouth on ingestion (Akpan and Umoh, 2004).

2.8 USES OF COCOYAM

The corms which have a light purple colour due to phenolic pigments (McGee, 2004) are roasted, baked or boiled and the natural sugar gives a sweet nulty flavor. The starch is easily digestible and grains are kin and small and often used for baby food. The leaves are a good source of vitamin A and C and contain more protein than the corms.

The West Africa, it is consumed as a staple crop particularly in Nigeria, Ghana and Cameroon.

The corms and cormels may be pounded either pure or mixed with yam and cassava and eaten with vegetable soup. They can also be boiled or roasted and eaten with palm oil, stew, meat, and fish in Nigeria (OnomawEgbeku, 1998). Cocoyam chips are produced from the corm called Achichain Nigeria. The corms have a light purple colour due to phenolic pigment (McGee, 2004) are roasted, baked or boiled and he natural sugar gives a sweet nutty flavor, the starch is easily digestible and grains are fine and small and often used for baby food. The leaves are a food source of vitamin A and C and contain more protein that the corms.

The cocoyam *colocasia*(taro) and *xanthosoma*(**Tania)** are the most important genera of the family Aracea used for food in West Africa. Alocasia Amorphophallus and caryotosperma are three other general common in the tropical area of the pacific. The corms and cormels may be pounded either pure or mixed with yam and cassava and eaten with vegetable soup. They can also be boiled or roasted and eaten with palm oil, stew, meat or fish (Onimawo and Egbekun, 1998) two main products, cocoyam chips (achicha) and the flour are produced from cocoyam (taro). The manufacture of "achicha", the raw corms are cleaned, washed and boiled for 2.5-3 hours until they are soft and colour changes from white to flesh. The skin is then peeled, cut into 1cm3 slices, sun or smoke dried until they readily brake between the fingers, packed in day pots and stored. "Achicha" is crushed into small grits, boiled and mixed with copious quantities of leafy vegetables and palm oil to form a meal. Adequate boiling neutralizes the irritancy and caustic smell associated with raw and improperly boiled cocoyam and promotes the development of a pleasant aroma (Onimawo and Egbekun, 1998).

2.9 PROCESSING METHODS OF COCOYAM

Cocoyam leaves are among the numerous foliages used traditionally by small holder farmers in many tropical countries to feed animals, particularly pigs. (Preston, 2006). They have been reported to be rich in protein, amino acids, vitamins and minerals (Leterme et al. 2005; Mbofun et al, 2006). However, realization of their full potentials is adversely affected by their content of oxalic acid (or its salts referred to as oxalates), an anti-nutritional before feeding (Nooman and Savage, 1999; Savage and Dubois, 2006; Buntha et al. 2008a). The oxalates are also present in the corm (skin and flesh as well as leaves and stem. Depending on the plant species, the oxalic acid can occur as free acid, as soluble salt of potassium, sodium and ammonium ions (soluble oxalates) or as insoluble salts of calcium, iron and magnesium ions (insoluble oxalates) or as a combination of the two salt (Noonan and Savage, 1999). When large quantities of a high oxalate containing feed are consumed by animals particularly non-ruminants). The oxalic acid binds the minerals leading to their reduced availability for absorption (Savage et al, 2000) several processing methods are (cooking, soaking, ensiling, germination,Wilting, sun-drying e.t.c) have been reported to reduce the oxalate content in coco yam leaves (Brad Burg and Nixon, Noonan and Savage, 1999; Buntha et Al, 2008b). However, it is important to understand the effectiveness of this processing method. In this study, boiling and soaking only remove the water soluble fraction of the total oxalate (soaking oxalate), the insoluble fraction removes reasonable constant (Savage and Dubois, 2006; Oscarsson and Savage, 2007). Boiling may also cause considerable skin (epidermal rupture and facilitate the leakage of soluble oxalate. With Wilting, there are fewer chances for leaching losses to occur (only a small amount of water is lost), has slight reduction in oxalate content from the Wilting treatment. After and ensiling (to a crawl or tuba into a silo or silage clamp to preserve it as silage) for 21 days, the resulting silage was of good quality based on smell, colour and pH (4.5). Silage fermentation has been associated with enhanced cell wall degradation (Baytok et Al; 2005), which could have facilitated their leaching of soluble oxalate. Ensiling does not only reduce the oxalate content but also preserve the feed for later use (Alvin and Savage, 2001b).

3.0 MATERIAL AND METHODS

3.1 SOURCE OF MATERIALS

The matured two bags of cocoyam (Xanthosoma sagittifollium) where purchased with wheat flour alongside with other ingredients mainly fat, sugar, x, baking powder and salt in relief market Owerri Imo State.

Preparation/ processing of cocoyam

The method of cocoyam was carried out as described by Onimawo, (1998), the coco yam tubers were selected, peeled and washed thoroughly with water to remove trace of sand and dirt's. The coco yam tubers with sliced in various small shapes are spread on a stainless tray and allowed to dry through sun drying for today's producing crispy dried chips. It was then dried milled with the use of manual milling mention into cocoyam flour at Douglas market owerri, imo State and packaged with plastic container to prevent moisture pick up.

Cocoyam
↓
Peeling
↓
Washing with water
↓
Slicing
↓
Sun drawing for two days
↓
Milling
↓
Packaging
↓
Labelling

Fig. 1.0 flow diagram of cocoyam flour production.

Recipe used in the production of cookies from blends of wheat and cocoyam

Table 1

Wheat	Cocoyam	Mangarine (g)	Sugar	Baking powder (g)	Salt (g)	Eggs
A 100	-	50	50	2.5	A pinch	1
B 90	10	50	50	2.5	A pinch	1
C 85	15	50	50	2.5	A pinch	1
D 80	20	50	50	2.5	A pinch	1
E 50	50	50	50	2.5	A pinch	1

The method used for processing of the cocoyam into flour was as described by Onimawo (1998).

The method procedures described by Victor et Al. (2000) was followed for the production of cookies from cocoyam and wheat flour using the recipe in table 1.

Methods for cookies production

Mixing of the ingredients used was firstly done by mixing the butter and sugar together as in the method of production of cake. The flour was sieved into a separate bowl. After mixing the butter and sugar, EK was added to the mixture and mixed. Baking powder, and a pinch of salt, where added intermittently into the proportion of flour (samples) of cocoyam and wheat flour using the ratio (100:0), (90:10), (80:20), 50:50). They were all kneaded and a size 3 mm high was rolled out, cut accordingly to shapes and picked with a fork to aid aeration. The cookies were then placed ungreased baking tray in an oven in a moderate temperature of 175-200^n C for about 45 minutes full stop the cookies were removed from the pan and allowed to cool for about 30 minutes then packaged and kept prior for analysis.
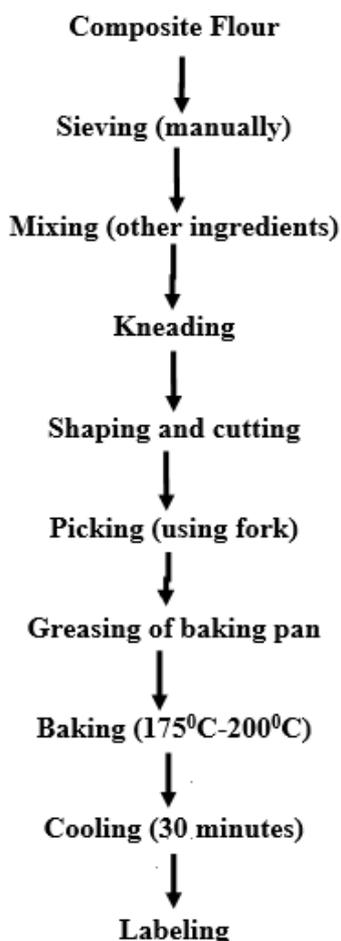
Composite Flour
↓
Sieving (manually)
↓
Mixing (other ingredients)
↓
Kneading
↓
Shaping and cutting
↓
Picking (using fork)
↓
Greasing of baking pan
↓
Baking (175^0C-200^0C)
↓
Cooling (30 minutes)
↓
Labeling

Fig 2.0 Flow diagram for cookies production.

PROXIMATE ANALYSIS OF WHEAT – COCOYAM COMPOSITE COOKIES

The method described A. O. A. C (1990) were used in the analysis of moisture content, protein content, fat, ash, crude fibre and carbohydrate of the samples was determined by total difference.

3.4.1 DETERMINATION OF MOISTURE CONTENTS

This is done by the gravimetric method (AOAC, 1990).

A measure weight of the sample (5.0g) was weight in to previously weighed moisture can. The sample in the can was dried in an oven at 105 for 3 hours. It was cooled in desiccators and weighed. It was then returned to the oven for further drying: Drying, cooling and weighing were done repeatedly at hourly (one hour) interval until there were no further diminutions in the weight. (i.e constant weight was obtained.

The weight of moisture lost was calculated and expressed as a percentage of the weight of sample anal sized. It was given by the expression below;

% moisture content = 100 X W_2- W_3— $W_2 W_1$
                                      $\overline{1}$

Where W_1 = weight of empty moisture can

W_2 = weight of empty can + sample before drying

W_3 = weight of can + sample dried to constant weight

3.4.2 DETERMINATION OF PROTEIN

This was by the Kjeldahl method described by change (2003). The total N_2 was determined and multiplied with factors 6.25 to obtain protein content.

Procedure; Half gramme (0.5g) of the sample was mixed with 10mls of conc.H_2SO_4 in a digestion flask.

A table selenium catalyst was added to it before it was heated under a fume cupboard until a clear solution was obtained (i.e. the digest). The digest was diluted to 100mls in volumetric flask and used for the analysis.

10ms of the digest was mixed was mixed with equal volume of 45 NaOH solution in a kjedahl distillation apparatus. The mixture was distilled in to 10ml of 4% buricacid containing 3 drops of mixed indicator (bromoscressol green methyl red). A total of 50mls of distillate was collected and titrated against 0.02N EDTA (Ethylene diamine tetra acetic acid) from green to a deep red and point. A regent blank was also digested, distilled and titrated.

The N_2 content and hence the protein content was calculated using the formula below;

% protein = % N_2 X 6.25

% N_2 = $\left[\dfrac{100}{w} \times \dfrac{N \times 14}{100} \times \dfrac{VI}{\frac{T.B}{va}} \right]$

W= weight of sample (0.5g)

N = normality of titrant (0.02N H_2SO_4)

Vt = Total digest volume (100 m/s)

Va = volume of digest analyzed (10ml)

T = sample titre value

B = blank titre value

3.4.3 ASH DETERMINATION

This was done by the furnaces incineration gravimetric method (James 1995). Five grammes (5.0g) of the processed sample were measured into a previously weighed porcelain crucible. The sample was burnt to ashes in a muffle furnace at 550. When it has become completely ashed, it was cooled in a desiccators and weighed. The weight of ash obtained was calculated by difference and expressed as a percentage of the weight of sample analyzed as shown below:

% Ash = $\dfrac{100}{} \times \dfrac{W2-Wi}{1\,wt\,of\,sample}$

Where W_1= weight of empty crucible

W_2 = weight of crucible + ash

3.4.4 DETERMINATION OF CRUDE FIBRE

The weaned method (James 1995) was employed. 5.0g of the processed sample was boiled in 150 m/s of 1.25% H_2SO_4 solution for 30 minutes under reflux. The boiled sample was washed in several portions of hot water using a two-fold Mushin cloth to trap the particles. It was returned to the flask and boiled again in 150 m/s of 1.25% NaOH for another 30 minutes under same condition. After washing in several portion of hot water, the sample was allowed to drain being transferred quantitatively to a weighed crucible where it was dried in the oven at 105 to a constant weight. It was burnt until only ash was left of it.

By difference, the weight of fibre was obtained and expressed as a percentage of the weight of sample analyzed. It was given by the formula below:

% crude fibre = $\dfrac{100\,(W2-W3)}{wt\,of\,the\,sample.}$

Where W_2 = weight of crucible + sample after boiling, washing and drying

W3 = Weight of crucible + sample as ash

3.4.5 DETERMINATION OF FAT

The solvent extraction gravimetric method (Kirk and Sawyer, 1998) was used 5.0g of the sample wrapped in a porous paper (white man filter paper) and put in a thimble. The thimble was put in a sox let reflux flask amounted into a weighed extraction flask containing 200m/s of petroleum either. The upper end of the reflux flask was connected to a water condenser.

The solvent (petroleum ether) was heated, it boiled, vaporize and condense into the reflux flask, soon the sample in the thimble was covered with the solvent, which extract the oil (fat) the sample remained in contact with the solvent until the reflux flask filled up and sip and over, carrying its oil extract down to the boiling flask.

This process was allowed to go on repeatedly for 4 hours before the default sample was removed, the solvent recovered and the oil extract was left in the flask (containing the oil extract), was dried in the oven at 60^{α} for 30mins (to remove any residual solvent). It was cooled in desiccators and weighed: by difference, the weight of oil (fat) extract was determined and expressed as a percentage of the weight of sample analyzed and given by the expression below:

$$\% \text{ fat} = \frac{W2 - W1}{wt \; of \; sample} \; X \; \frac{100}{1}$$

Where W1 = weight of empty extraction flask

W2 = weight of flask of oil (fat) extract

3.4.6 DETERMINATION OF CARBOHYDRATE

It was calculated using the formula below as described by James (1995)

% carbohydrate = 100 - % (protein + fat + fibre + Ash + moisture content).

3.4.7 SENSORY EVALUATION AND STATISTICAL ANALYSIS

Sensory evaluation was conducted for the cookies sample by a 12 member semi-trained consumer's type sensory panel draw from members of Imo State University Owerri. They were asked assess for Aroma/flavor, taste crispness/texture appearance/color and overall acceptability using 7 – point hedonic scale, with 7 indicating like extremely and I, dislike extremely (Iwe, 2002). Five samples of the cookies product were served to 12 panelist who were asked to score using 7 point hedonic scale. According to Kent (1975) a cup of water at room temperature will be given to the panelist for mouth rising before assessing any other

sample after the first assessment for taste. The score obtained were added and then, the means were recorded. Analysis of variance (ANOVA) was carried out to determine the difference among the sample using one factor randomized design ANOVA as described by O' Mahoney (1986).

4.0 RESULTS AND DISCUSSION

4.1 PROXIMATE COMPOSITION OF COOKIES FROM WHEAT –COCOYAM FLOUR

PROTEIN CONTENT

The mean proximate composition of protein was shown in table (2) as 6.13 ± 0.30, 6.01 ± 0.10, 5.72 ± 0.10, 5.37 ± 0.10 and 5.14 ± 0.10 for control sample A samples B, C, D, E respectively.

The mean value of the five samples of cookies were significantly different at ($p<0.05$).

Control sample A (100:0) had the highest mean value of 6.13 ± 0.30 while sample E(50:50) has the least mean value of 5.14 ± 0.10

The result implies that the difference in the protein content of the five samples of cookies were as a result of high substitution of wheat with cocoyam. According to normal (2004) cocoyam contains high content of carbohydrate which will reduce the protein content of wheat even though cocoyam is fairly high in protein content.

TABLE 2.0

MEANS SENSORY SCORE FOR WHEAT/COCOYAM COMPOSITE COOKIES

Sample/Parameter	100:0	90:10	85:15	80:20	50:20	
	A	B	C	D	E	LSD
Colour/Appearance	6.25 ± 1.06 a	5.83+0.83a	5.45+1.24ab	5.75+1.14a	4.50+1.88b	1.06
Crispiness/Texture	6.08+173ab	5.50+2.11b	5.25+097b	6.50+067a	5.25+36B	0.84
Taste	6.58+0.51a	5.67+1.07ab	5.42+0.51b	6.42+0.51a	5.25+154b	0.77
Aroma/Flavour	6.17+0.58a	5.33+1.15bc	5.83+083ac	5.67+1.07ab	5.08+1.24ab	0.74
Overall Acceptability	6.75+0.45a	5.50+0.90b	5.67+0.78ab	6.25+0.87a	5.17+1.70	0.85

Means in the same now with the same superscript are not significantly different at p<0.005

MOISTURE CONTENT

The mean proximate composition for moisture content was good when compared with the work of (Okpala, 2011) which has the moisture content of (6.7%). The moisture of the samples were recorded as 6.79 $\pm$0.03, 5.34 $\pm$1.77, 5.94 $\pm$0.14, 4.17 $\pm$ 0.03 and 3.17 $\pm$ 0.01 for control sample A and sample B,C,D and E respectively.

The percentage mean value for the sample differs significantly at (p< 0.0005). the control sample A has highest moisture content of 6.79 $\pm$0.03 while the least was recorded for sample E. (50:50) as 3.17 $\pm$0.01.

This implies that there is more damaged starch as well as higher protein content in wheat flour than in cocoyam.

According to Kamel and Stauffer (1993), the water absorption requires to produce dough of a certain constituency is an important flour specification affected by protein quality and quantity moisture content and level of damage starch; milling of hard wheat inevitably increases starch damage over that of soft wheat's, leading to increased water absorption. Furthermore, it was emphasized that starch damage levels should be sufficient high that desirable improvement in loaf volume and crumb tenderness can occur, but not so highly that dough handling and fermentation problems are encountered.

The reduced moisture content can increase the shell life and organoleptic properties of the baked production especially sample E.

The reduction in the moisture content of the sample or food materials might be due to the effect of change in temperature.

According to Ekopetal. (2007) when any food materials are exposed to a temperature above 100^0C all a most of the moisture content that food materials would be reduced because the boiling point of water at standard atmospheric pressure is 100^0C

FAT CONTENT

The percentage mean fat for the cookies ranged from 26.09 $\pm$ 0.08 to 28.28 $\pm$ 0.13 for control samples B, C, D, E respectively. The percentage fat different significantly at (p<0.05) sample A(100.0) which is control had the highest mean value of 28.02 $\pm$0.13 while the least value was recorded in sample E (50:5) of 26.09 $\pm$0.08. The increase in the fat content could be as result of addition of shortening in the baked production in addition to the fat content of the composite flours.

FIBRE CONTENT

The percentage mean fibre for the cookies ranged from 0.43 ± 0.01 to 1.09 ± 0.03. For control sample A, B, C, D and E respectively. The percentage crude fibre content differ significantly at $(p<0.05)$. Sample E(50:50) has the highest mean score of 1.09 ± 0.03 while the least was recorded in sample A (100:0) of 0.43 ± 0.01.

The increase in the fibre content of the cookies as the cocoyam flour substitution increased. It could improve nutritional content of the cookies with respect to fibre which in turn will aid easy digestion of the production.

The fibre content of the cookies increased as the level of substation of wheat flour with cocoyam increased.

ASH CONTENT

The ash content ranges from 2.53 ± 0.01 to 1.82 ± 0.02. for control sample A and samples B, C, D, E respectively.

The percentage of ash contend did differ significantly at $(p< 0.05)$ sample A (100:0) has the highest mean value of $2.53 \pm 2.53 \pm 0.01$ while the least mean value was recorded 1 sample E(50:50) of 1.82 ± 0.02.

The result shows that the five cookies samples were appreciably high in ash content compared with other baked products like biscuit which improved the nutritional composition of the cookies.

The ash content decreased as the level of substitution of wheat flour with cocoyam flour increased.

CARBOHYDRATE CONTENT

The carbohydrate content ranged from 56.32 ± 0.48 to 62.67 ± 0.14. For control sample A and sample B, C, D, respectively.

The percentage for carbohydrate content varied significantly at $(p<0.05)$. Sample E (50:50) has the highest mean value of 62.67 ± 0.14. While the least value was recorded in sample A (100.0) of 56.32 ± 0.48. In general the result implies that the all cookies sample were high in carbohydrate content and it could e used as a supplement for alternative carbohydrate during carbohydrate deficiency in diet. Kaukauna and Silo (1990) reported that variation exist in the proximate composition of fruit, seed and nut across tree location (origin) season at the time of harvest and degree of maturity and processing method.

The carbohydrate content increased as the level o substitution increased.

SENSORY EVALUATION OF COOKIES SAMPLES

The result of mean sensory score from cookies of composite flour of wheat and cocoyam were as presented in table (2). The result of variance (ANOVA) showed significant difference at (p<0.05) for appearance, crispiness, taste, aroma and overall acceptability of the cookies.

APPEARANCE

The sensory scores for appearance were shown in table (2) as 6.25+1.06, 5.82 +0.83, 5.42 +124, 5.75 +1.14 and 4.50 +1.88. For control A and B, C, D, E respectively. The percentage mean value of appearance differ significantly at (p<0.05) sample A (100:0) having the highest mean score 6.25+1.06 while the least mean score was recorded in sample E (50:50) of the 4.50 +1.88

The result implies that sample A with mean values of 6.25 +1.06 is the most preferred followed by Sample B (5.38 +0.83) by the judges. The variation in appearance could be attributed in one part of the degree of mail lard reaction and in the other part, variance in the temperature time of baking.

TABLE 3.0 The mean proximate composition of wheat/cocoyam composite cookies.

Sample/Parameter	100:0	90:10	85:15	80:20	50:20	
	A	B	C	D	E	LSD
% moisture content	6.79 + 0.3a	5.34+1 77a	5.94+0 14a	4.17+0 03b	3.17+0 01b	1.45
% protein	6.13+0 30a	6.01+0 10a	5.72+0 10ab	5.37+0 10c	5.14+0 10c	0.32
% fat	28.02+ 0.13a	27.41+0 .04b	26.31+ 0.42c	26.31+ 0.42c	26.35+ 0.05c	0.36
% Crude fiber	0.43+0 01a	0.85+0 02a	0.91+0 04a	0.96+0 02a	1.09+0 03a	
% Ash	2.53+0 01a	2.51 +0 01a	1.85+0 02a	1.85+0. 01a	1.82+0 02a	
% Carbohydrate	56. 32+ 0.48C	57.89+1 .70bc	59.27+0 43ab	61.31+ 0.09a	62.67+ 0.14a	

Means in the same row with the same superscript are not significantly different at p<0.005.

CRISPNESS

The sensory for crispness were shown in table 92) as 6.08 $\pm$1.73, 5,50 $\pm$2.11, 5.25 $\pm$0.97, 6.50 $\pm$0.67 and 5.25 $\pm$1.36 for control sample A and sample B,C,D, E respectively. The percentage mean value of crispness varied significantly at ($p<0.05$). Sample D (80:20) had the highest mean score of 6.50$\pm$0.67 while the least value was recorded in sample C. (85:15) with mean score of 5.25 $\pm$0.97. the result indicate that sample D (80:20) of 6.50$\pm$0.67 is the most preferred in terms of crispness.

The control sample A (100:0) of 6.08 $\pm$1.73 did not vary with sample D with mean score of 6.50$\pm$0.67 respectively.

TASTE

The sensory scores of taste were shown in table (2) as 6.58 $\pm$0.51, 5.67 $\pm$1.07, 5.42 $\pm$0.51, 6.42 $\pm$o.51 and 5.25 $\pm$1.54 for control sample A, B, C, D, E respectively. The percentage mean value of taste differ significantly in all the samples at ($p<0.05$).

Sample A has the highest mean score of 6.58 $\pm$0.51 followed by sample D (80:20) which is 6.58 $\pm$ 0.51. While the least was recorded in sample E (50:50) with value of 5.25 $\pm$1.54. This could be as a result of high level of substitution with cocoyam which may have negatively affected the taste of the cookies compared to the control sample.

AROMA

The sensory scores of aroma were shown in the table (2) as 6.17$\pm$0.58, 5.33 $\pm$ 1.15, 5.83 $\pm$0.83, 5.67 1.07 and 5.08 $\pm$1.24 for control sample A,B,C,D,E respectively.

The percentage mean value of aroma differ significantly at ($p<0.05$). control A (100:0) has the highest mean score was recorded in sample E (50:50) of 5.08 $\pm$ 1.08. This could be that the high substitution of wheat with cocoyam flour did not the reaction of organic acid and alcohol through the process of etherification which adds distinct flavor to baked goods.

OVERALL ACCEPTABILITY

The sensory scores of overall acceptability were shown in the table (2) as 6.75 $\pm$0.45, 5.50 $\pm$0.90, 5.67 $\pm$0.78, 6.25 $\pm$ 0.87 and 5.17 $\pm$ 1.70 for control A and samples B, C, D, E respectively.

The percentage mean value of overall acceptability differed significantly at ($p<0.05$). The cookies sample A (100:0) has the highest mean value of 6.75 $\pm$0.45 while the least was recorded in sample E (50:50) of 5.17 $\pm$1.70. The result indicates that the cookies sample

made from (100:0) of wheat with mean score of 6.75 $\pm$0.45 is the most preferred among the test samples followed by sample D (80:20) 6.25 $\pm$ 0.87.

The indication from the result shows that the potential of higher illusion of non wheat flour (cocoyam) up to 20% in cookies production gives acceptable cookies regards to sensory attributes or quality.

5.0 CONCLUSION AND RECOMMENDATIONS

From this research, the percentage of carbohydrate composition were high in all the cookies samples given from the result of the proximate composition carried out, also the sensory evaluation in terms of taste, aroma, crispness, appearance, shows that addition of 20% of cocoyam flour in the baked cookies improved the sensory quality of the cookies and could serve as supplement for alternative carbohydrate during carbohydrate deficiency in diet. This study therefore complements the work of many researchers on cocoyam and its nutritional qualities creating awareness on the industrial potentials and its products domestically and industrially. Inspite of high nutritional value of cocoyam, the rate at which most Nigerians consume cocoyam is still low when compared to other root and tuber crops. Malnutrition and other developing nations are traced to the consumption of low quality and quantity of food.

The findings of this study underscore the potential of cocoyam flour as a valuable ingredient in cookie production, particularly for enhancing the carbohydrate content and sensory attributes of the final product. The high carbohydrate composition observed across all cookie samples, as determined through proximate analysis, highlights the nutritional contribution of cocoyam. Furthermore, the sensory evaluation revealed that incorporating 20% cocoyam flour significantly improved the cookies' taste, aroma, crispness, and overall appearance, suggesting a positive consumer perception and acceptance of this formulation. This enhancement in sensory quality is crucial for promoting the consumption of cocoyam-based products and addressing carbohydrate deficiencies in diets. The utilization of cocoyam flour in baked goods presents a viable strategy for diversifying food sources and improving nutritional intake, especially in regions where cocoyam is readily available.

This research builds upon the existing body of knowledge regarding cocoyam and its nutritional benefits, further emphasizing its industrial applications and potential for both domestic and industrial use. Cocoyam's rich nutritional profile makes it a promising candidate for addressing malnutrition and food insecurity, particularly in developing nations. However, despite its high nutritional value, the consumption rate of cocoyam remains relatively low in Nigeria compared to other root and tuber crops. This disparity highlights the

need for increased awareness and promotion of cocoyam as a staple food. Addressing malnutrition in developing nations requires a multifaceted approach, including improving the quality and quantity of food consumed. Cocoyam, with its high carbohydrate content and potential for sensory enhancement in food products, offers a valuable resource for combating malnutrition and promoting food security. Future research should focus on developing innovative cocoyam-based products and strategies for increasing its consumption among diverse populations. Further studies could explore the optimal processing methods for cocoyam flour to maximize its nutritional value and sensory appeal, as well as investigate its potential use in other food applications beyond cookies. Additionally, efforts to educate consumers about the health benefits of cocoyam and promote its integration into local diets are essential for realizing its full potential as a nutritional resource.

5.2 RECOMMENDATION

This study therefore recommends that future research should be aimed towards improving the quality of cookies produced from wheat flour and cocoyam flour. Further research should be made on utilization of the other species of cocoyam part from (Xanthosoma Sogittifollum) In the production of cookies and should be encouraged. Also, based on the proximate analysis of the five (5) cookies samples, I recommend that a trial run should be made for experimentation to determine the appropriate recipe to adopt.

To elaborate on the initial recommendation, future research endeavors should prioritize the enhancement of cookie quality through the optimized utilization of wheat and cocoyam flour blends. This involves a multifaceted approach, encompassing the investigation of various processing techniques, ingredient ratios, and the incorporation of supplementary additives to achieve desirable textural, sensory, and nutritional attributes. Specifically, studies should focus on the impact of different cocoyam flour particle sizes, pre-treatment methods (such as roasting or fermentation), and the inclusion of gluten-enhancing agents to improve the overall baking performance and consumer acceptability of the resulting cookies. Furthermore, the optimization of baking parameters, including temperature, humidity, and baking time, is crucial to ensure uniform cooking and prevent undesirable characteristics such as excessive hardness or crumbliness.

In addition to Xanthosoma Sagittifolium, the exploration of other cocoyam species presents a promising avenue for diversifying the raw material base and potentially uncovering novel functional properties. Different cocoyam varieties exhibit variations in starch composition, fiber content, and bioactive compounds, which can significantly influence the nutritional

profile and health benefits of the final cookie product. Research should therefore be directed towards characterizing the physicochemical properties of various cocoyam species and evaluating their suitability for cookie production. This may involve assessing their starch gelatinization behavior, water absorption capacity, and interactions with other ingredients in the cookie formulation. Moreover, sensory evaluation studies are essential to determine consumer preferences for cookies made with different cocoyam species and to identify any potential off-flavors or textural defects that may need to be addressed through appropriate processing techniques.

The recommendation for a trial run to determine the appropriate recipe underscores the importance of empirical experimentation in optimizing cookie formulations. This involves systematically varying the proportions of wheat flour, cocoyam flour, sugar, fat, and other ingredients, and evaluating the resulting cookies based on a range of quality parameters. Response surface methodology (RSM) or other statistical design approaches can be employed to efficiently explore the design space and identify the optimal combination of ingredients that yields the desired cookie characteristics. The trial run should also incorporate sensory evaluation by a panel of trained assessors to obtain quantitative data on attributes such as appearance, aroma, taste, texture, and overall acceptability. Furthermore, shelf-life studies should be conducted to assess the stability of the optimized cookie formulation over time and to determine appropriate packaging and storage conditions to maintain product quality and prevent spoilage. The data obtained from these experiments will provide valuable insights into the complex interactions between ingredients and processing parameters, enabling the development of a robust and reliable cookie recipe that meets consumer expectations and nutritional requirements.

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