Sub-Sahara African Academic Research Publications
September, 2023, Editions

JRATR
Journal of Renewable Agricultural Tech. Research
Vol. 29, No.1, ISSN 2813 – 9650

QUALITY DETERMINATION OF COOKIES FROM BLENDS OF COCOYAM (*XANTHOSOMASAGITTI FOLIUM)* AND BAMBARA GROUNDNUT (*VIGNA SUBTERRANEAN*) FLOUR

BULUS DANIEL SADIQ (PhD); & TANKO O ODENI,
Dept. of Food Technology Federal Polytechnic,P.MB 1012 Kaura Namoda, Zamfara State Nigeria.

Abstract
Production and Quality evaluation of cookies from blends of cocoyam and bambara nut flour were studied using standard methods, the flour were mixed at various ratio of 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 of cocoyam to bambara groundnut flour as samples P1, P2, P3 P4, P5 and P6 respectively. The flour and product (cookies) were subjected to proximate, functional and sensory evaluation (NOAC 2000). The proximate analysis of the cookies for the protein ranged from 10.68±0.01 to 19.29±0.08, the moisture ranges from 9.23±0.01 to 9.67±0.01 and carbohydrate 60.50±0.08 to 76.67±0.04. The result of the functional properties of the flour were between 0.55±0.01 to 0.80±0.01 for the swelling index and 50.50±0.71 to 84.50±0.71 for wettability. The result of the sensory evaluation shows that there was no significant difference ($P<0.05$) in the colour, texture, taste and overall acceptability and there was significant difference ($P<0.05$) in flour of the product at 5% degree of freedom

Key Words; Cookies, Bambara groundnut, Cocoyam, Blends, Cormels

INTRODUCTION

The cornels of *Xanthosoma sagittifolium* are a good source of starch. *Xanthosoma sagittifolium* is from tropical America, introduced to West Africa in the 16th -17th centuries. Today, cocoyam is cultivated in new Caribbean, Central and tropical America, West Africa, Central Africa, South East Asia, Oceanic and New Caledonia. It is an important source of calories for nearly 100million people worldwide. Cocoyam is the second most important crop after cassava.

Cookies are a form of confectionery products usually dried to low moisture content, larger and softer compared to biscuits (Okaka, 2009). They are mostly eaten all over the world as a snack food and on a large scale in developing countries where lack of protein and malnutrition prevail (Chinma and Genaah, 2007). The food industry is confronted with the problems of manufacturing food products containing functional ingredients to meet the functional requirements of the individual with malnutrition problems.

Cookies can, therefore, serve as a means of delivering vital nutrients if made readily available to the population (Chinma and Genaah, 2007). Cocoyam is a tropical plant cultivated primarily as a root vegetable for its edible corms. It is a substantial source of energy food and a well-recognized staple food which is a very good means of dietary fibre (Boudjeko et al., 2005). Cocoyam consumption is impaired by the presence of acridity factors like oxalates tannins etc. which causes sharp irritation and burning feeling in the throat and mouth when eaten. (Enomfon-Akpan and Umoh, 2004). Bambara nut is a good source of fibre with high nutritional function usually; Wheat flour has been used in recent times in the production of cookies. However, the use of cocoyam flour and Bambara flour in baking or cookies production flour can help bridge the gap of protein and calorie malnutrition. It can as well save Nigeria the scarce foreign exchange since it will discourage the importation of wheat as well as enhance industrial utilization. The acridity factor can be prevented or minimized by peeling, soaking, grating and fermentation operation during processing *(*Ojinaka *et al.,* 2009) Nutritionally, cocoyam *(Xanthosoma sagittifolium*) exhibits greater advantage over other tuber and root crops; it is rich in vitamin B6 and magnesium which helps to control high blood pressure and protect the heart (Agwunobi *et al.,* 2000) Although cocoyam is less important than tropical root crops like cassava, it is still a major staple in some parts of the tropics (Ojinnaka *et al.;* 2009). Despite the economic importance of cocoyam *Xanthosoma sagittifolium*) as a food material is some part of the tropic and sub-tropics, there is limited information on their post-harvest characteristics which perhaps contributes to the very limited application of enhancing post-harvest technologies to maintain quality and improve marketing potential (Kent and Evers, 1994).

The main nutrient in cormels of cocoyam is carbohydrates, and *Colocasia esculenta* contains about 13% and *Xanthosoma sagittifolium* 17-20% of carbohydrates on a fresh weight basis (Oti and Akobundu, 2007). The

The anti-nutritional factors found in cocoyam are oxalates, phytates, tannins and saponins (Abdulrashid and Agwunobi 2009). However, some may serve as a defensive mechanism against pest and disease. Therefore, oxalates have been found to be a defensive mechanism and a storage reserve for calcium (Smith, 1982).

Bambara nut is a seed of Africa origin used locally as a vegetable. The plant is leguminous and has numerous nitrogen-fixing nodules on the root. The quest for the plant with nutritional properties keeps on receiving attention. Bambara nut which constitutes complete foodstuff is reported to contain protein, carbohydrate and lipid can be consumed at different stages of maturity (National Research Council 2006).

Bambara nut has been found to be useful for baby food, human consumption industrial products and for animal feed (Akani, 2000).

The seeds are used for food and drinks due to their protein content and for digestive system application

MATERIALS AND METHODS

The various raw materials used for the research obtained from Institute for Agricultural Research Ahmadu Bello University (ABU) Zaria

Sample Preparation

Cocoyam flour production

The Cocoyam cornels were sorted, peeled and trimmed with the aid of a kitchen knife. The cormels were thoroughly washed with clean water and manually sliced into very light slices of about 1.3mm thickness. The slice cormels were blanched using hot water at 750C for 15minutes and drained using a perforated plastic sieve. After that, the blanched cormels were sundried by spreading on a mat, on a raised platform for 3days. After properly dried to yield a flour of fine texture, the resulting powder was packed in a cellophane bag and stored in an airtight container at room temperature until further use. The cocoyam flour was produced using the method described by Oti and Akobundu, (2007).

Preparation of Bambara nut flour

The Bambara nut was prepared according to the method of Iwe (2003). During preparation, 1kg of grain of Bambara nut weighed after sorting and cleaning. The seed was soaked in water over night and removed manually. It was drained; the seed was then spread on the oven set at 70^0c for drying for 2hours. After drying, it was allowed cooled and then grind using grinding machine. The flour was allowed to cool and sieved, using a sieve of 5.33µm

Table 1: Blend Formulation

Sample	Cocoyam	Bambara nut
P1	100	0
P2	90	10
P3	80	20
P4	70	30
P5	60	40
P6	50	50

Source: Iwe (2003)

Table. 2 Cookies Formulations

Materials	Quantity (g)
Flour	100
Margarine	50
Salt	0.2
Sugar	33.3
Egg	26.6
Milk	10
Baking powder	3.3
Vanilla flavour	0.2
Nut meg	0.5

Source (Okaka, 2009

Mixing

Before mixing, the oven was pre-heated, and sheets greased, and the ingredients weighed. The weighed fat and sugar was creamed with a wooden spoon until soft and white in a mixing bowl, the eggs, was then whisked into it and blended by mixing. Milk, flour and the other ingredients added into the mixture. It was needed until smooth and lump less and then rolled out thickly. The dough was cut which a cookie cutter into a précised size and shape and the place gently on the oven tray then baking starts. After-baking it was spread on the clean working table and allowed to cool, packaged and labelled.

Baking The six blend formulations were baked using a temperature of 1600C for 15minutes. After baking it was spread on a table and allowed to cool, it was then packaged and labelled.

Proximate Composition

The moisture, crude, protein, fat, ash crude fibre contents of the samples were determined in triplicate according to the method of AOAC (1990) carbohydrate was determined by difference.

Moisture

The weight of the petri dish to be used was taken and recorded, 2g of the sample flour was measured into a petri dish of known weight, the sample was heated at a temperature of 120^{0}C for 2hours and its weight was determined. The heating was repeated for 30minutes at the same temperatures and the weight was taken respectively. The procedure was repeated until constant weight was obtained.

$$\% \text{ Moisture} = \frac{W_1 - W_2}{\text{Wt of sample}} \text{ X } 100$$

Where

W_1 = Initial weight of crucible + Sample

W_2 = Final weight of crucible + Sample

Crude Protein

The method described by Kjeldahl was followed principle; the principle of this method is to digest the organic matter with sulphuric acid in the presence of catalyst, render the reaction alkaline, the distil and titrate the liberate ammonia

Procedure:

5g of the sample was weighed and dissolved in 50ml of distilled water

3drops of 0.5% phenolphthalein was added to the portion of the sample collected in separated in a separated beaker

It was then neutralizing with little quantity of 0.1m of NaOH to obtained to pink colour, 0.5ml of formation was added to the sample to remove the pink colour

A blank titration was carried out using 100ml of distilled water.

The percentage total nitrogen was calculated as shown below

$$\% \text{ Total Nitrogen} = \frac{Titre\ Value\ X\ normality}{Weight\ of\ Sample}\ X\ 0.014\ X\ 100$$

% protein = % Total Nitrogen x 6.25

Where 6.25 = conversion factor of protein

Fat content Determination

Procedure

5g of sample flour were weighed into labeled thimbles, the correspondingly labeled cooled steillized flasks was weighed and filled with about 300ml of petroleum ether (boiling point 40-60^{0}C)**,** the extractor thimbles were plug lightly with cotton wool**,** the Soxhlet apparatus were assemble and allowed to reflux for about 6hours, `the thimble was removed with care and petroleum ether was collected in the top container of the set up and was drained into a container for re-use. It was then removed and dried at $105^0C – 11^0C$ for 1hour when flask was almost free of petroleum ether, it was transferred from the oven into a desiccator and allowed to cool, it was then weighed

The % fat in the sample was calculated as follows:

% fat = $\frac{W_3 - W_1}{W_2}$

Where,

W_1 = Weight of fat free extraction thimble

W_2= Weight of sample

W_3 = Weight of sample plus thimble after drying

Crude Fibre

This was done using the method described by Pearson, (1981). 5 grams of the sample was weighed and transferred to an extractor apparatus and extracted with light petroleum ethyl, the extracted sample was air dried and transferred to a 100ml conical flask, 200ml of 0.25m sulphuric acid measured at ordinary temperature was added and brought to boiling point within 1minutes while the first 40ml was used to disperse the sample, an appropriate amount of anti-forming agent was added, the mixture was boiled gently for exactly 30minutes maintaining a constant volume by the use of reflux condenser and rotating the flask every few minutes boiling water was poured into Buchner funnel filled with filter paper. To cover the holes and allowed to remain until the funnel was hot and drained by suction. After 30minutes of boiling the acid mixture was allowed to stand 400l per minute and poured immediately into a shallow layer of hot water under gentle suction in the prepared funnel. The suction was washed with boiling water until free from acid. It was then washed back into the original flask with 200ml of 0.313 sodium hydroxide solution measured at ordinary temperature and brought to boiling point contained in a wash bottle. The mixture was boiled for 30minutes with the same pre-containers as those used in the earlier boiling and treatment. It was allowed to stand for one (1) minutes and filtered immediately though a suitable filter paper. The whole insoluble matter was transferred to the filter paper means of boiling water and washed first with 1% HCL and finally with boiling water until free from acid then it was washed twice with alcohol and three times with ether. The insoluble matter was transferred to a dried weighed ash less filter paper and dried at 100% to a constant weight. The paper and content was calculated from data obtained. The process was repeated with other sample crude fibre was calculated by subtracting the weight of ash from the increase of weight on the filter (paper due to insoluble material and the difference reported as fibre.

$$\% \text{ Crude fibre} = \frac{\text{Loss in Weight on Ignition}}{\text{Weight of food sample}} \text{ X } 100$$

Carbohydrate

The total carbohydrate content was estimated as the difference between 100 and the total sum of moisture, fat protein, ash and crude fibre

Carbohydrate as Nitrogen free extract was calculated by difference as

NFE = 100 – (% crude protein + % fat + % Ash + % Moisture + % Crude Fibre)

Where NFE = Nitrogen free extract

Determination of Functional Properties

Bulk Density

According to Nwanekezi *et al* (2001), 5g of the sample was weighed and was transferred into a 250ml graduated density of the cylinder, the cylinder was tapped on the table & the finale volume was noted. This was done until the sample stopped setting for about 2minutes. The bulk density was calculated by dividing the ration of the mass of the sample by the settled volume

$$\text{Bulk Density (g/ml)} = \frac{Weight\ of\ Sample}{Volume\ occupied}$$

Swelling Index

The swelling index was measured using (Nwankezi *et al* 2001). 5g of the sample were weighed each and transferred into 100ml graduated cylinder, it was tapped gently and eliminated, 100ml of water was added and was stirred round and was allowed to stand for 30minutes and then the volume was noted.

Initial granules volume = W_1

Final Granules = W_2

$$\text{Swelling Index} = \frac{W_2 - W_1}{W_1}$$

Wettability

The method described by Onwuka (2005) was used. One gram of each of the flour blends was weighed using an analytical balance and were added into 25ml graduated measuring cylinder with a diameter of 1cm. the finger was then placed over the open end of the cylinder in each case, inverted and was clamped at a height of 10cm from the surface of 600ml beaker containing 500ml of distilled water. The finger was removed and the test sample was allowed to be dumped.

The wettability was recorded as the time required for the sample to become completely wet.

Sensory Evaluation

The sensory Evaluation of cookies produced from blends of cocoyam and Bambara groundnut flours was carried out using the method described by Iwe, (2002). Fifteen (15) member panelist drawn from department of Food Technology of Federal Polytechnic Kaura Namoda assessed attributes like, colour, taste, texture, flavour and overall acceptability using a nine-point hedonic scale. The result obtain was subjected to statistical analysis using the analysis of variance

Results and discussion

Table 3 Proximate Analysis

Parameter	P1	P2	P3	P4	P5	P6
Moisture (%)	9.23±0.01[a]	9.38±0.05[b]	9.48±0.11[b]	9.36±0.06[b]	9.46±0.01[b]	9.67±0.01[c]
Protein (%)	10.68±0.11[a]	11.12±0.01[b]	13.91±0.02[c]	14.35±0.01[d]	16.36±0.04[e]	19.29±0.08[f]
Fibre	1.79±0.01[a]	3.08±0.02[b]	3.23±0.01[c]	3.43±0.02[d]	3.67±0.01[e]	3.78±0.01[f]
Fat	2.15±0.01[a]	3.17±0.01[c]	3.28±0.08[d]	3.33±0.01[d]	3.03±0.04[b]	3.34±0.02[d]
Ash	1.56±0.01[a]	2.05±0.04[b]	2.72±0.02[e]	3.06±0.01[d]	3.21±0.01[e]	3.44±0.01[f]
CHO	76.61±0.04[ab]	84.20±1.10[b]	67.40±0.19[ab]	66.49±0.09[ab]	64.29±0.07[ab]	60.50±0.08[a]

Values are means of standard deviation of determinations ($p \leq 0.05$)

Table 4 Functional Properties of the Flour Blends

Parameter	P1	P2	P3	P4	P5	P6
Bulk Density (g/g)	0.57± 0.01[b]	0.05±0.01[a]	0.56±0.01[ab]	0.57±0.01[b]	0.56±0.01[ab]	0.55±0.01[a]
Swelling index	0.80±0.01[e]	0.71±0.01[d]	0.61±0.01[c]	0.37±0.01[b]	0.08±0.01[a]	0.10±0.02[a]
Wettability	84.50±0.71[f]	64.50±0.71[b]	67.50±0.71[c]	71.50±0.71[d]	74.00±0.00[e]	50.50±0.71[a]

Values are means of standard deviation of determinations ($p \leq 0.05$)

Table 5. Sensory Evaluation

Parameter	Colour	Taste	Texture	Flavour	Overall Acceptability
P1	7.15±1.61[a]	7.13±1.30[a]	6.87±1.30[a]	7.93±1.33[b]	7.80±1.37[a]
P2	7.07±1.10[a]	6.60±1.30[a]	6.60±1.35[a]	6.63±1.44[a]	7.67±1.11[a]
P3	7.00±1.07[a]	7.07±1.16[a]	7.53±1.41[a]	7.40±1.06[ab]	7.27±1.28[a]
P4	7.27±0.96[a]	7.00±1.20[a]	7.07±1.03[a]	6.87±1.51[a]	7.07±1.39[a]
P5	6.13±1.03[a]	6.67±1.35[a]	6.80±1.08[a]	6.80±1.37[a]	7.13±0.99[a]
P6	7.27±1.44[a]	6.80±1.42[a]	6.60±1.30[a]	6.67±1.50[a]	7.13±1.41[a]

Values are means of standard deviation of determinations ($p \leq 0.05$)

Discussion

Proximate composition of the cookies produced from flour blends of cocoyam and Bambara groundnut flour is presented in table 1. The protein content of the product ranged from 10.6±0.01 to 19.29±0.08 for (P1 and P6), respectively. The high protein content in P6 could be attributed to the protein Quality in the Bambara groundnut flour, this indicates that the processing temperature of the cookies does not have any deleterious effect on the protein composition in the Bambara ground nut flour. There is a significant difference in all the samples. This may be due to the different amount of Bambara groundnut flour in the formulations. The highest moisture content of the product is 9.67±0.01 for sample P6; The findings is in agreement with the report of Nwalike (2001), good indication that there will be some degree of stability in the shelve, because of the average moisture content of the product. On the average there is no significant difference in the moisture content of the formulations. The highest fibre content of the cookies 3.78±0.01, the recommended daily fibre intake is 25g-30g/d, if consumed along other fibre containing foods could serve as a good supplement. Ash content of the product has a minimum value of 1.56±0.01 and a maximum value of 3.441±0.01, the ash content increases as the amount of Bambara g/nut is increase in the formulations. Bambara g/nut is a good source of minerals Enwere and Hung (2009).

The fat content of the product ranged from 2.15±0.01 to 3.34±0.02 for, the result of the fat content of the low lipid content if stored in an appropriate atmosphere. For fat content P1 is significantly different from others, so also P2 and P5, but for P3, P4 and P6 there is no significant difference among them.

The cookies showed an average of 70% carbohydrate content in all the ratios, it therefore, shows that it is a high calorie products value that can be administered for fast energy requirement.

Bulk density (Table 2) ranged from 0.55±0.01 to 0.57±0.01 for samples P6 and P1, respectively. The swelling index of the flour also showed that is of good baking quality. Okpala *et al.,* (2013) observed the same trend in cookies produced from pigeon pea/sorghum/cocoyam composite flours. The low spread factor of the control sample showed that starch polymer molecules are highly bound with the granules and swelling is limited when heated. The wettability of the flours is from 50:50±0.71 for sample P6 to 84.50±0.71 for sample P1 which is also another more exceptional indication results for baking quality of the flour.

Sensory evaluation of the individual baked composite cookies (Table 3); the results shows that at 5% level of significance that there were no significant difference in the colour, texture, taste and overall acceptability of the products but its flavour has significant difference (P<0.05), sample P2, P3, P4, P5 and P6 are not significantly different from each other but are different with sample P1 except for sample P3 which is not significantly different (P<0.05) from sample P1. These results indicate that the product is very much acceptable by the panelist.

CONCLUSION

Results from this work showed that cocoyam (*Xanthosoma sagittaifolium*) flour could be used in the production of quality cookies. Also, Bambara ground nut could be used to supplement protein deficiency in cocoyam flour in the production of cookies without adversely affecting the sensory attributes of the products. Cookies made from higher levels of Bambara ground nut supplementation had average mean scores ranging from approximately 6.0 – 7.0 for most of the attributes, they were fairly accepted by the judges. Also the proximate attributes showed that legume can be used to improve the protein content of the cocoyam flour for different food formulations.

REFERENCE

Abdulrashid, M and Agwunobi, L.N. (2009). Taro Cocoyam (*Clocasia esculenta)* Meal as Feed Ingredient in Poultry. *Pakistan J. of nutritio*n 8(5): 668-673

Abulude F.O (2004): Effect of Processing on Nutrition Composition, Phytate and Functional Properties of Rice (*Oriza sativa*) flour. *Nigeria food journal.* Vol. 22

Agwuonobi, L.N. Okafor, E.P and Ohazuruike, N. (2000). Tannia cocoyam tuber Meal (*Xanthosoma sagittifolium)* as a Replacement for Maize Grain in the Diet of Rabbits. *Global J. pure and applied* Sci. 6:419-423

Akani, G.C, and Angelici F.M (2000) Optimization of Proximate Composition and Functional Properties of Composite Flour Consisting of Wheat Cocoyam and Bambara Groundnut *British journal of applied science and technology*

AOAC (1990) Official Method of Analysis (15th ed) Association of Official Analytical Chemists, Washington DC, USA Pp. 332

Boudjeko, T., Omokolo, N.A., Driouich, A. and Balam (2005). Cocoyam Nutritional Quality

Bough S. Pushkarev. B and Zupan, J. (1992). The Proximate Composition of Bambara Groundnut Production, Marketing and Consumption in the Brong Ahafo and Upper East Region of Ghana J. Agron, 9:111-118

Chinma, C.E and Germah, D.I. (2007) Physiochemical and Sensory Properties of cookies Produced from Raw Material Resource. 4:32-43

Enomfon –Akpan, J. and Umoh, I.B. (2004). Effect of Heat and Tetracycline Treatment on the Food Quality and Acridity Factors in Cocoyam (Xanthosoma sagittifolium) (L) Schools Pak.J. Nutri 3:240-243

FAO (1990) Roots, Tubers, Plantain and Banana in Human Nutrition. Food and Agricultural organization of the United Nation Rome

Ihekoronye, A.I and Ngoddy P.O (1985): Integrated Food Science and Technology for the Tropics Macmillan publishers Ltd, London

Iwe, M.O. (2002) Handbook of Sensory Method and Analysis, (2nd edition) Region Communication Service ltd Enugu *Nigeria journal of phytopathology* 153:7-8 Pp 409-416 (80

Kent, N and Ever, A.D. (1994). Technology of Cereals: An Introduction for Students of Food Science and Agriculture, (4th ed). Pergamon Press. Oxford

Nwanekezi, E.C; Ohagi N.C. and Afam Amene, O.C. (2001) Nutritional and Organoleptic Quality of Infant Food Formulations Made from Natural and Solid State – Cocoyam flour blend Ng. Fd. Y 19:55-62

Ojinnaka, M.C.Akobundu, E.M.I. and Iwe, M.O.(2009). Cocoyam Starch Modifications Effects on Functional, Sensory and Cookies Qualities *Pak. J. Nutri*. 8:558-567

Okaka, J.C, Akobundu, E.N.T and Okaka, A.N. C (1992). Human Nutrition. An Integrated Approach ESUT Publication, Enugu, Nigeria Pp. 108

Okika, J.C. (2009). Handling, Storage and Processing of Plant Foods. Academy publisher Enugu Nigeria, Page 132

Onwuka, G.I. (2005). Food Analysis and Instrumentation (Theory and practice) Division of Cross Check Support Nig. Ltd. Pp:64-70

Oti, E; and Akobundu, E.N.T. (2007). Physical, Functional and Amylograph Pasting Properties of Cocoyam- Soybean Crayfish Flour Blend *Nigeria food journal* 25 (1)