

# Production and Quality Evaluation of Pringles from Composite Flour of Cocoyam and Wheat Flour

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Received: October 28, 2013 / Published: April 20, 2014.

**Abstract:** Work assessed “Pringles” as an imitate snack produced from composite flour of cocoyam and wheat. This was carried out in order to exploit the nutritional and aesthetic value of cocoyam (*Colocasia esculenta* Var.) to improve the overall quality of the Pringles as against its production from potato and wheat composite flour. Composite flour (100%:0%, 90%:10%, 80%:20%, 70%:30%, 60%:40% and 50%:50%) of cocoyam and wheat respectively as the major raw materials were adopted and used for the production of the Pringles. Physicochemical analysis (pH, water absorption capacity (WAC), bulk density (BD) and swelling capacity (SC)); proximate analysis (protein, fats, ash, moisture and carbohydrate content) and sensory evaluation (colour, texture, taste and overall acceptability) were carried out on the samples produced using standard methods. Physicochemical analysis showed the pH of 5.48 to 6.61, WAC (12.00 to 17.50), BD (1.43 to 1.56) and SW (1.03 to 1.38). However, sample with 10% cocoyam and 90% wheat composite flour gave the best physicochemical properties of pH (5.98), WAC (14.00), BD (1.56) and SC (1.38). The proximate analysis showed that carbohydrate content ranging between 53.36 to 61.12, and protein content (8.17 to 12.29), fat content (16.67 to 23.97), ash content (3.49 to 45.53), fiber content (1.71 to 2.83) and moisture content (8.76 to 14.54). Sample B equally gave the nutrient proximate combination of appreciable percentage on the average. The result of the sensory evaluation showed that there is no significant difference between the samples produced in terms of aroma. There is a significant different between samples A, B and the remaining samples in terms of colour and taste. On the overall acceptability, samples A, C and D showed no significant difference but the highest mean score was found with sample B. Conclusively, acceptable snack (Pringles) can be produced from cocoyam and wheat in ratio 90%:10%, respectively.

**Key words:** Pringles, cocoyam, nutrients, chemical, sensory.

## 1. Introduction

Snack has been defined as a light, quick meal eaten between, or instead of a main meal. Although snacks are known to have bad reputation on assessment with the main meal, the wise use of nutritious snacks can improve the health and vitality of physically active people who lead a hectic lifestyle. Wholesome snacks may boost energy, take the edge off appetite and provide useful nutrients. Snacks may include dry cereal, fruits, nuts, seeds and some vegetables which can be eaten raw or cooked, such include carrots, tiger nuts, walnuts, palm kernel, etc. [1]. Healthy snacks

summarized that snacks should contain trans fats, sugars and sweetened beverages. A snack should be balanced nutritionally, should provide quick energy, easy to eat, and should be of great taste. Ultimately, snacks should be perceived as healthy.

Pringles is a famous brand of snack produced from the composite flour of potato and cereals, it is marketed by Procter and Gamble, a global manufacturing corporation which has its headquarter in Cincinnati. Pringles derives its name from Pringle Street Town in Finney, Ohio, United State of America. The name apparently came into being because it sounds pleasing to the ear. Pringles has become so popular that it has found its way into over 140 countries across the globe with accruing revenue

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worth billions of dollars a year [2]. Pringles is composed majorly of dried potato, vegetable oils (may contains one or more of corn oil, cotton seed oil, soybean oil and sunflower oil), rice flour/wheat starch, maltodextrin, salt and dextrose.

Product development is an approached through the process of both recipe development and an adaptation of a “brand” name recipe. The techniques of product development from both views indicate that product development does not exist in a vacuum [3]. They have three principles of defend, extend and build. Product development includes defending a product through brand protection, food safety, scientific and regulatory affairs, environmental and consumer relations. Food science recently indicated the importance of putting fundamental consumer interest, research, consumer yield analysis and product performance research to make successful product.

Cocoyam is recognized as cheaper carbohydrate sources than grains or other tuber crops. It has high calorie yield per hectare, low production cost and relatively low susceptibility to insect and pest attack. Similarly, it is reported that cocoyam has readily digestible starch content because of its small granules. Cocoyam has the highest protein content among the tubers. The use of cocoyam as food for man and animal has been limited by the presence of anti-nutritional factors. The anti-nutritional factors found in cocoyam include oxalates, phytates, tannins, and saponins. However, some may serve as defensive mechanism against pest and diseases. Oxalates have been found to be used as a defense mechanism and storage reserve for calcium [4]. In addition, processing like peeling, soaking, blanching, boiling, cooking and the likes have been known to reduce these factors drastically and these has actually allayed the fear and the anticipated risk that may be associated with its consumption.

Cocoyam has only been consumed by boiling and eating, cooking and pounding like pounded yam, preparation like porridge and drying to produce

cocoyam flour. It should also be stressed that due to the low utilization of cocoyam, it is inexpensive. It is not also susceptible to chilling injury as other tropical tuber crops. As a result of these peculiar characteristics and advantages of cocoyam, this research work is aimed at producing and evaluating the quality of Pringles from composite flour of cocoyam and wheat while keeping all other materials constant.

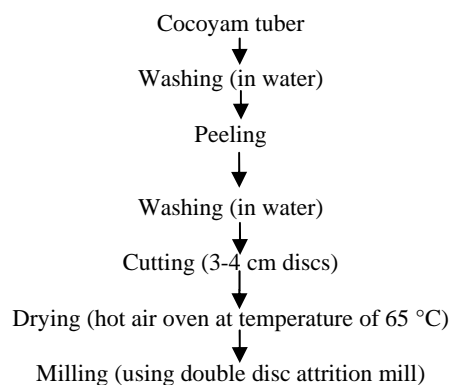
## 2. Materials and Methods

### 2.1 Materials

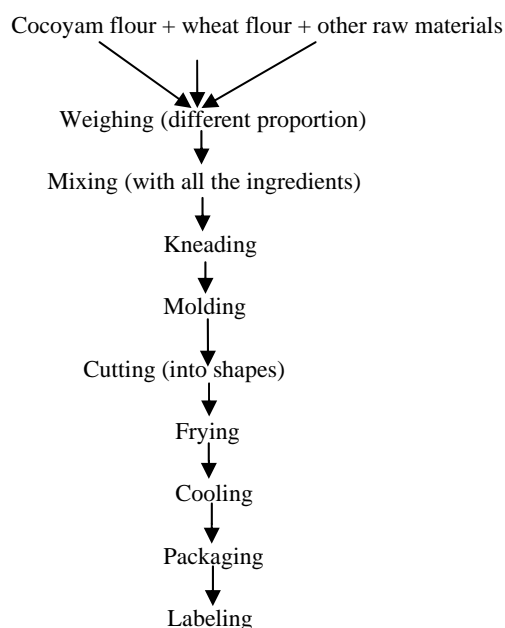
Cocoyam flour, wheat flour, whey, groundnut oil, salt, sugar, spices for this research work were obtained from a reliable retailer in Oja-igbo, Ogbomoso, Oyo State, Nigeria. All the chemicals and the equipments used were of analytical grade and food standard, all obtained from the Department of Food Science and Engineering, Ladoké Akintola University of Technology, Ogbomoso.

### 2.2 Methods

Cocoyam tubers were washed, peeled and rewashed. It was cut into 3-4 cm thick discs and weighed. The slices were arranged randomly on the drying trays in a single layer and placed in the drying machine (hot air oven dryer) maintained at the temperature of 65 °C for 9 h. The next day, the cocoyam oven dried at 100 °C for 1 h to dry off the moist according to the method in Ref. [5]. Afterwards, it was milled using a



**Fig. 1** Flow chart for the production of cocoyam flour.



**Fig. 2** Flow chart for the production of Pringles using composite flour (cocoyam and wheat).

double disc attrition milling machine into flour and sieved using a Kenwood Food Mixer-KN (Fig. 1). Six composite samples were prepared by mixing the formulation of cocoyam and wheat composite flour.

### 2.3 Production of Pringles Using Composite Flour (Cocoyam and Wheat)

Cocoyam and wheat flour were both weighed in different proportion and mixed after which all the other weighed ingredients (water, groundnut oil, whey, salt, sugar and spices) were added to the composite flour. It was then mixed thoroughly, kneaded to obtain smooth dough. The smooth dough was then molded into shapes. These were fried, cooled, packaged and labeled (Fig. 2).

### 2.4 Analysis

#### 2.4.1 Physicochemical Analysis

Water absorption capacity, bulk density, pH and swelling index were determined using standard methods as recorded in Refs. [6-8].

#### 2.4.2 Proximate Analysis

The proximate analysis was carried out using the methods of Ref. [7]. The ash content was determined

with the use of muffle furnace and moisture content was determined by oven drying method. The crude fat was extracted using solvent extraction, crude protein was determined by Kjeldahl method and the value obtained multiplied by 6.25. Crude fibre was determined by digestion method and carbohydrate by difference.

#### 2.4.3 Sensory Evaluation

The samples were subjected to sensory evaluation with regards to color, appearance, taste and overall acceptability. The analysis of variance (ANOVA) statistical approach was used in obtaining the results.

## 3. Results and Discussion

### 3.1 Physico-Chemical Properties

Data on physico-chemical composition of Pringles were as presented in Table 2. Swelling capacity is the amount of water that has been entrapped by a food sample in order to increase in size. This is usually determined to know the quantity of the flour that will make up the dough and how economical the product will be. The swelling capacity varies with the increase in the percentage of potato flour in the snacks. All the samples are significantly different from one another at

5% level. Sample A ( $1.25 \pm 0.01$ ), B ( $1.38 \pm 0.01$ ), C ( $1.16 \pm 0.01$ ), D ( $1.03 \pm 0.01$ ), E ( $1.15 \pm 0.01$ ) and F ( $1.11 \pm 0.01$ ). Sample B (10% cocoyam addition) gave the highest value of  $1.38 \pm 0.01$ . The implication of this is that this sample will give a bigger volume of dough and so higher product qualities. The water absorption capacity (in percentage) is the quantity of water uptake by a composite material when immersed in water for a stipulated period of time. It indicates the volume of water required to form dough with suitable consistency for frying. The result from the analysis showed that sample B (10% cocoyam addition) had  $14.00\% \pm 0.11\%$ , WAC, which is the highest value recorded, others are sample A ( $13.50 \pm 0.11$ ), C ( $13.50$ ), D ( $12.50 \pm 0.11$ ) and E ( $10.50 \pm 0.11$ ). Bulk density is the weight of unit volume of a loose material to the same volume of water. Sample C ( $1.47 \pm 0.01$ ) and sample D ( $1.47 \pm 0.00$ ) as well as sample E ( $1.57 \pm 0.01$ ) and sample F ( $1.49 \pm 0.01$ ) are insignificantly different from each other while other samples such as sample A ( $1.43 \pm 0.01$ ) and sample B ( $1.56 \pm 0.01$ ). The result of bulk density is useful in

packaging of the final products, this will determine the space the product which occupy in the packaging material. pH measures the degree of alkalinity and acidity of a food sample (pH 1-6 indicates acidic, 7 indicates neutral, and 8-14 indicates alkaline (basic)). It is important in food because of its potency to predict microbial growth thus a good means of determining spoilage. Some microorganism can grow at low pH and near at neutral pH of some fruits in Ref. [9]. Table 1 showed that there was significant difference between all the samples.

### 3.2 Proximate Composition

Proximate analysis showed that carbohydrate content ranges between  $53.36 \pm 0.01$  and  $61.12 \pm 0.01$  which falls between the recommended daily intake [8], and protein content between  $8.17 \pm 0.01$  and  $11.69 \pm 0.01$ . It is observed that only sample F with  $8.17 \pm 0.11$  falls outside the range of 10%-35% as recorded in Ref. [7]. Fat content between  $16.67 \pm 0.00$  and  $23.97 \pm 0.01$ , according to the previous research, only sample A falls within this range, although fat content in food

**Table 1 Formulation of Pringle using wheat flour and cocoyam flour.**

Samples	Components					
	Wheat (%)	Cocoyam (%)	Groundnut (g)	Salt (g)	Sugar (g)	Ginger (g)
A	100	0	3	2	4	1
B	90	10	3	2	4	1
C	80	20	3	2	4	1
D	70	30	3	2	4	1
E	60	40	3	2	4	1
F	50	50	3	2	4	1

Sample A = 100% wheat flour and 0% cocoyam flour (control); sample B = 90% wheat flour and 10% cocoyam flour; sample C = 80% wheat flour and 20% cocoyam flour; sample D = 70% wheat flour and 30% cocoyam flour; sample E = 60% wheat flour and 40% cocoyam flour; sample F = 50% wheat flour and 50% cocoyam flour.

**Table 2 Physicochemical composition of Pringles made with cocoyam flour and wheat flour.**

Sample	Physicochemical properties			
	Swelling capacity	Bulk density	WAC (%)	pH
A	$1.25 \pm 0.01$	$1.43 \pm 0.01$	$17.50 \pm 0.21$	$6.16 \pm 0.00$
B	$1.38 \pm 0.01$	$1.56 \pm 0.01$	$14.00 \pm 0.11$	$5.98 \pm 0.03$
C	$1.16 \pm 0.01$	$1.47 \pm 0.01$	$13.00 \pm 0.00$	$5.93 \pm 0.01$
D	$1.03 \pm 0.01$	$1.47 \pm 0.00$	$12.50 \pm 0.21$	$5.87 \pm 0.01$
E	$1.15 \pm 0.02$	$1.57 \pm 0.01$	$10.50 \pm 0.11$	$5.74 \pm 0.00$
F	$1.11 \pm 0.01$	$1.49 \pm 0.01$	$12.00 \pm 0.00$	$5.48 \pm 0.01$

Sample A = 100% wheat flour and 0% cocoyam flour (control); sample B = 90% wheat flour and 10% cocoyam flour; sample C = 80% wheat flour and 20% cocoyam flour; sample D = 70% wheat flour and 30% cocoyam flour; sample E = 60% wheat flour and 40% cocoyam flour; sample F = 50% wheat flour and 50% cocoyam flour.

should be minimal. The ash content ranged between  $3.49 \pm 0.01$  to  $4.73 \pm 0.01$ . These values are within the range of values expected of foods. The fibre content varied between  $2.00 \pm 0.11$  and  $2.63 \pm 0.00$  and moisture contents also varied between values  $8.76 \pm 0.01$  and  $14.54 \pm 0.01$ . Moisture content of most snacks and dry foods is usually less or equal to 12% [9]. The values obtained for the Pringles samples indicate that they will keep longer with sample A having the minimum value. Carbohydrate is organic compounds with a function of supplying calories. The carbohydrates content found in Pringles samples meets the standard value by the Institute of Medicine. Although the Food and Agriculture and World Health Organization jointly recommended that national dietary guidelines set a goal of 55%-67% of total energy for carbohydrates. From the table, the value meets this standard implying that the samples are capable of supplying the daily calorie needed with the highest value found with sample D. Protein content is necessary for growth and maintenance of tissues. It was found to range between  $4.28 \pm 0.01$  and  $11.29 \pm 0.01$ . Protein content of foods usually ranged between 10%-35%. This indicates that only sample B ( $12.29 \pm 0.01$ ) has

the maximum value. Ash content for most foods usually does not exceed 5% [4]. Crude fibre content ranges between  $1.72 \pm 0.01$  and  $2.84 \pm 0.01$  and they are within the daily intake (1.33%) as recorded by Ref. [2].

### 3.3 Sensory Evaluation

The result of the sensory evaluation is shown in Table 3. All the samples, A, B, C, D, E and F have mean separations to be 5.42<sup>a</sup>, 6.53<sup>a</sup>, 6.63<sup>a</sup>, 6.53<sup>a</sup>, 6.42<sup>a</sup> and 6.74<sup>a</sup> for aroma, respectively; 4.53<sup>a</sup>, 5.79<sup>a</sup>, 6.74<sup>b</sup>, 6.63<sup>b</sup>, 6.84<sup>b</sup> and 7.00<sup>b</sup> for colour, respectively; 4.74<sup>a</sup>, 5.79<sup>b</sup>, 6.53<sup>c</sup>, 6.47<sup>c</sup>, 6.84<sup>c</sup> and 7.05<sup>c</sup> for taste; 5.42<sup>a</sup>, 6.21<sup>a</sup>, 6.74<sup>ab</sup>, 7.00<sup>ab</sup>, 6.63<sup>b</sup> and 7.32<sup>c</sup> on the overall acceptability, respectively. For all the samples of the Pringles analyzed, there was no significant difference between all the samples at 5% level as far as aroma is concerned except for sample A (5.42<sup>a</sup>). In terms of colour, samples C, D, E and F have no significant difference from sample A and B. For taste, samples C, D, E and F are significantly different from samples A and B. For the overall acceptability, all the samples were significantly different from one another but sample F (7.32<sup>a</sup>) is rated as the most acceptable.

**Table 3 Proximate composition of Pringles made from composite flour (cocoyam and wheat flour).**

Samples	Proximate (%)					
	Protein	Fat	Fibre	Moisture	Ash	CHO
A	11.29 ± 0.01	23.97 ± 0.01	2.00 ± 0.01	8.76 ± 0.01	3.49 ± 0.01	60.08 ± 0.01
B	12.29 ± 0.00	18.96 ± 0.01	2.04 ± 0.01	10.95 ± 0.00	4.73 ± 0.01	60.05 ± 0.01
C	11.29 ± 0.01	18.96 ± 0.01	2.08 ± 0.01	10.34 ± 0.01	4.40 ± 0.01	58.05 ± 0.00
D	11.69 ± 0.01	18.45 ± 0.00	2.20 ± 0.01	10.92 ± 0.01	4.29 ± 0.01	61.12 ± 0.02
E	10.89 ± 0.01	16.76 ± 0.00	2.39 ± 0.01	12.13 ± 0.01	4.67 ± 0.01	58.40 ± 0.00
F	8.17 ± 0.01	16.67 ± 0.00	2.63 ± 0.00	14.54 ± 0.01	4.53 ± 0.01	53.36 ± 0.01

Key: CHO (%) = 100 – (protein (%) + fats (%) + crude fibre (%) + moisture contents (%) + ash (%)).

**Table 4 Sensory evaluation of Pringles made from composite flour (cocoyam flour and wheat flour).**

Sample	Quality attributes			
	Aroma	Colour	Taste	Overall acceptability
A	5.42 <sup>a</sup>	5.53 <sup>a</sup>	4.74 <sup>a</sup>	5.42 <sup>a</sup>
B	6.53 <sup>a</sup>	5.79 <sup>a</sup>	5.79 <sup>b</sup>	7.32 <sup>b</sup>
C	6.63 <sup>a</sup>	6.74 <sup>b</sup>	6.53 <sup>c</sup>	7.32 <sup>b</sup>
D	6.53 <sup>a</sup>	6.63 <sup>b</sup>	6.47 <sup>c</sup>	7.00 <sup>ab</sup>
E	6.42 <sup>a</sup>	6.84 <sup>b</sup>	6.84 <sup>c</sup>	6.63 <sup>b</sup>
F	6.74 <sup>a</sup>	7.00 <sup>b</sup>	7.05 <sup>c</sup>	6.21 <sup>c</sup>

The same letter along a row means not significantly different ( $P < 0.05$ ).

#### 4. Conclusions

Based on the result of the analysis carried out, it can be seen that sample B (90% wheat flour and 10% cocoyam flour) is mostly accepted by the panelist and meets the nutritional needs required, hence, acceptable snack (Pringles) can be produced from cocoyam and wheat in ratio 90%:10%, respectively. Further work should be done on the storage life, packaging and also fortification especially for food rich in protein.

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