

# Proximate Composition and Sensory Qualities of Chips Produced From Ackee Aril Flour

Edward Ken Essuman<sup>1\*</sup>, Joycelyn Anima Osei<sup>2</sup>, Vida Gyimah<sup>2</sup>

<sup>1</sup>Ken Consult, P. O. Box KN 1154, Kaneshi-Accra, Ghana

<sup>2</sup>Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana

\*Corresponding author: [edwardessuman2000@yahoo.com](mailto:edwardessuman2000@yahoo.com)

**Abstract** People have different interests as to what product ackee fruit could be used for. A preliminary survey disclosed cake, chips and rock cake to be the preferred bakery products when ackee aril is to be blend with wheat flour. The study assessed the quality of chips produced from wheat-ackee aril composite flour. Four blends of chips were prepared in the proportions: 80:20, 60:40, 50:50 and 40:60 and wheat used as control. These were used to bake chips and proximate composition and sensory attributes of the chips were examined. Results of proximate analysis showed significant increase ( $p \leq 0.05$ ) in protein (10.2–16.9%), fat (2.1–20.2%) and fibre (0.5–3.7%) contents and significant decrease in carbohydrate (72.3–48.1%) contents with increase in ackee aril flour. There was no significant difference in the ash content of the test samples. Sensory evaluation results showed that all chips samples had high rating for all evaluated attribute. The closeness of values obtained for all chips samples to the control sample indicate a high level of acceptance of the WF-AF chips.

**Keywords:** *ackee aril, chips, wheat-ackee aril flour*

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## 1. Introduction

Chips are unleavened pastries made mainly from wheat flour providing energy, iron, calcium, vitamins and proteins. The consumption of cereal foods such as chips, biscuits and bread has become very popular in Ghana, especially consumption of chips among both children and elderly during Christmas festivity, birthday parties and weddings. Most of these foods are however, poor sources of protein with poor nutritional quality [1].

Wheat flour is one of the major conventional ingredients in pastry making due to its gluten fraction, which is responsible for the elasticity of the dough by causing it to extend and trap the carbon dioxide generated by yeast during fermentation [2]. However, in tropical countries, wheat production is limited and importation of wheat flour to meet local demand is a necessity [3]. Attempts have been made by many researchers to complement wheat flour with non-wheat flour, for pastry product [4,5]. In Ghana the major source of partial substitute for wheat in bread and pastry making are cassava, sorghum and millet. With increasing demand of bakery products which has led to importation of wheat, there is the need to source for locally processed flour from vegetables and fruits which can be used in partial substitution for wheat in the production of bakery products for consumption and industrial uses.

Ghana is endowed with ackee fruits (*Blighia sapida*) which are cheap, underutilized and the amount consumed is currently relatively low and there is the need to increase

public interest of the fruit because of its high dietary protein and many disease preventive properties. The ackee aril contains substantial quantities of lipid and thus is susceptible to oxidative rancidity. Generally solvents such as hexane, ethanol, petroleum ether, methanol, acetone and a mixture of chloroform and methanol have been used for the extraction of lipids from several seeds [6,7].

Both the skin and seeds of the ackee contain toxic hypoglycins A and B levels and are poisonous and can even be fatal [8]. The mature ackee fruit splits open naturally when it is ripe and care must be taken in harvesting the fruit at the right time and in the preparation of an ackee dish. The level of hypoglycin A in the ackee arils is much higher in the immature fruit than in the mature, open fruit [9]. Although Jamaican vomiting sickness (JVS) which is a common sickness associated to the consumption of immature ackee fruit, nowadays such incidences are rare as there is increased awareness of the necessity for consuming only ripe, opened ackees [10]. On the whole, properly picked and prepared ackee is delicious and considered safe to eat.

There is little data reporting composite of ackee aril with other cereals in bakery products except being canned in brine for export with Jamaica being the major exporter. When bakery products are made from composite flour, their overall quality (odour and flavor, chewing properties, appearance, and shelf-life) should be as similar as possible to those of products made from wheat. The amount added must be adjusted to the quality of the wheat flour. The percentage of wheat flour required to achieve a certain effect in composite flours depends heavily on the quality

and quantity of wheat gluten and the nature of the product involved. However, incorporating ackee aril flour into wheat flour in chips making may change the chemical properties of the flour as well as acceptability of the chips.

Hence this work was aimed at determining the effect of ackee aril flour additions on the chemical properties of wheat flour and evaluates the consumer acceptability of the reconstituted flour in chips making.

## 2. Materials and Methods

### 2.1. Research Location

A survey to perceive which bakery product could ackee fruit be used for when blend with wheat flour was under taken using students of Kwame Nkrumah University of Science and Technology, Kumasi-Ghana.

### 2.2. Sampling and Data Collection

A pre tested semi-structured questionnaire was prepared for the study. A total of 158 respondents were selected from the study area using random sampling technique. Information about which bakery product will be preferred when ackee aril is blend with wheat flour was gathered from the respondents.

The *Blighia sapida* (ackee fruit) that served as sample for analysis was harvested from ackee trees around the Agogo Hospital which is located in Kumasi, Ashanti Region. Only the fleshy pulp (aril) of ackee fruits opened naturally was harvested for analysis. Wheat flour,

hydrogenated fat, nutmeg, onion and salt were purchased from the Asafo market, in Kumasi.

### 2.3. Chemicals

All the chemicals and equipments used in this analysis were of analytical grade and were obtained from the biochemistry laboratory of the Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology.

### 2.4. Processing of Ackee Aril Flour

The edible portions (aril) of *Blighia sapida* was remove from the pulp using knife and solar dry for 2 weeks. The ackee fruit is rich in fat and makes getting fine flour difficult hence the dried sample was milled with a hammer mill into flour and deffated with n-hexane using a ratio of 1:10 w/v, with respect to flour/solvent for 24 h. The deffated ackee flour was repeatedly washed with clean water to get rid of all excess hexane and dried in a solar dryer. The ackee aril flour was milled again and sieve through a metal sieve of 160  $\mu\text{m}$  pore size. Ackee aril flour was sealed in polythene bags in airtight containers and kept in a refrigerator at 4 °C until ready for analysis.

#### 2.4.1. Flour Blends for Chips Preparation

The flour blends from wheat and ackee aril flour was done as shown in Table 1. The negative control sample was 100% wheat flour. Each sample was blended in a high speed blender to get a unified composite mix and sieved through a metal sieve of 160  $\mu\text{m}$  pore size.

Table 1. Recipe for chips production

| Flour blend sample | Ackee aril flour (%) | Wheat flour (%) | Salt (NaCl) (g) | Fag (g) | Nutmeg (g) |
|--------------------|----------------------|-----------------|-----------------|---------|------------|
| A                  | 0                    | 100             | 1.0             | 50      | 1.0        |
| B                  | 20                   | 80              | 1.0             | 50      | 1.0        |
| C                  | 40                   | 60              | 1.0             | 50      | 1.0        |
| D                  | 50                   | 50              | 1.0             | 50      | 1.0        |
| E                  | 60                   | 40              | 1.0             | 50      | 1.0        |

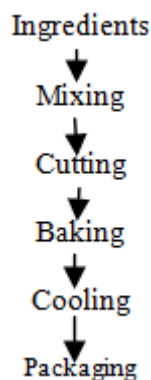


Figure 1. Flow chart for chips production

## 2.5 Method

### 2.5.1. Proximate Analyses of Blend Flour Ratio

Analysis of composited wheat-ackee aril flour for chips was carried out according to AOAC [11] based on the formulation as shown in Table 1.

### 2.5.2. Blend Formulation and Chips Production

Five blends were prepared by mixing wheat flour with ackee aril flour in percentages, as hown in Table 1. Chips were produced from the five blend formulations as shown in Figure 1. Fat, wheat flour and ackee aril flour were mixed together and then nutmeg, common salt and water were added to prepare dough. The dough was mixed for 15 min until a uniform smooth paste was obtained using hand. The paste was rolled on a flat rolling board sprinkled with the same flour to a uniform thickness using a wooden hand roller. Desired shape of chips were cut and baked in a pre-heated oven for 15 min. After baking, chips were cooled and then packed in tray pans and labeled according to formulations with codes prior to sensory evaluations.

## 2.6. Sensory Evaluation

The five samples obtained from the different fractions of wheat-ackee aril mixes and made into chips were subjected to sensory evaluation. The following attributes namely appearance, taste, texture, aroma and overall

acceptability were assessed on chips samples using a 9-point hedonic scale with 1= disliked extremely, 2 = disliked very much, 3 = disliked moderately, 4 = disliked slightly, 5 = neither liked nor disliked, 6= liked slightly, 7= liked moderately, 8 = liked very much and 9 = liked extremely. Fifty panelists familiar with chips, who were neither sick nor allergic to baked products, were involved in the assessment. The panelists were instructed to rinse their mouth with water after tasting each sample.

## 2.7. Statistical Analysis

Results were analyzed statistically using analysis of variance (ANOVA) and means were separated by Fisher's least significant difference (LSD) tests to ascertain significant effects at  $p < 0.05$  level of significance among treatments.

## 3. Results and Discussion

### 3.1. Respondents' Preferences on the Type of Ackee Aril Product

Respondents' choice on the type of ackee aril product is shown in Figure 2. Hence, result in bar chart showed that highest number of the respondents preferred cake and chips (20.3 %) followed by chips (19.0 %) and cake (16.5 %). Out of the 158 (100 %) respondents, no one opposed the development of ackee into bakery products and 6, representing 3.8 %, of the respondents do not know which bakery product ackee aril should be used. Out of the 3.8 % respondents, 2.5 % prefer turnover and 1.3 % none of the bakery products.

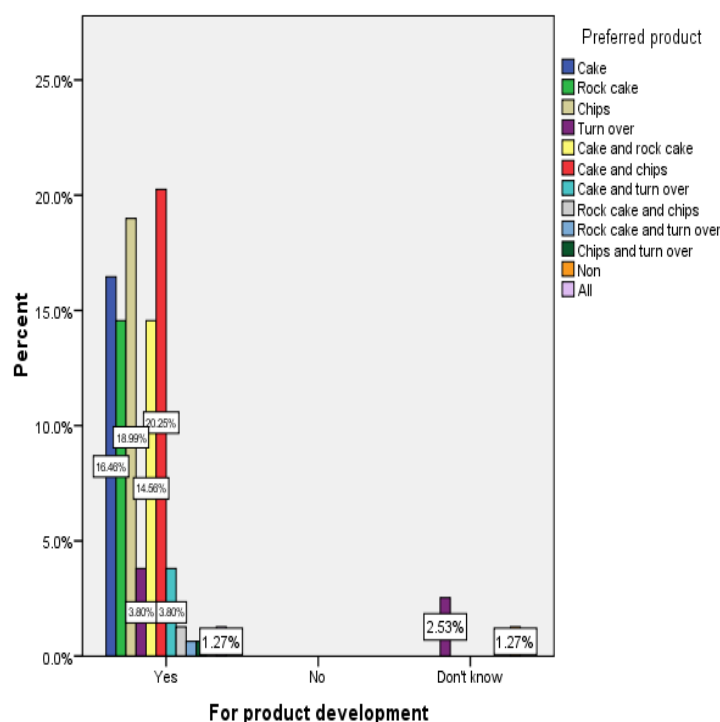


Figure 2. Respondents choice on the type of bakery product from ackee aril wheat blend

Some respondents mentioned other products like ackee flour, canned ackee oil, canned ackee and ackee paste which is not well known in Ghana but are being produced in other countries. Canned ackees has earned Jamaica US \$ 4.3 million (J\$223.3 million for 1,507,635 kg of ackee) in 1999 and US \$ 8.5 million in 2002 [12]. The economic potential of ackee is largely untapped in West Africa.

### 3.2. Chemical Composition of Wheat-Ackee Aril Flour

Significant variation was observed when portions of the wheat flour were substituted with ackee aril flour. The range of moisture contents of the mixture samples ranged between 7.7 to 15.4 % (Table 2).

Table 2. Chemical composition of wheat-ackee aril flour mixes

| Samples (%) | Moisture (%)          | Fat (%)               | Fibre (%)            | Ash (%)              | Protein (%)           | Carbohydrate (%)      |
|-------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|
| A=100 WF    | 12.8±0.0 <sup>c</sup> | 2.1±0.1 <sup>a</sup>  | 0.5±0.0 <sup>a</sup> | 2.0±0.0 <sup>a</sup> | 10.2±0.2 <sup>a</sup> | 72.3±0.1 <sup>c</sup> |
| Control     |                       |                       |                      |                      |                       |                       |
| B= 80:20    | 11.4±0.0 <sup>b</sup> | 9.6±0.1 <sup>b</sup>  | 1.1±0.0 <sup>b</sup> | 2.5±0.7 <sup>a</sup> | 10.8±0.2 <sup>a</sup> | 64.5±1.0 <sup>d</sup> |
| WF : AF     |                       |                       |                      |                      |                       |                       |
| C= 60:40    | 15.4±0.0 <sup>d</sup> | 14.8±0.4 <sup>c</sup> | 1.3±0.1 <sup>b</sup> | 3.5±0.7 <sup>a</sup> | 13.6±0.6 <sup>b</sup> | 51.5±0.3 <sup>b</sup> |
| WF : AF     |                       |                       |                      |                      |                       |                       |
| D= 50:50    | 8.8±0.3 <sup>a</sup>  | 17.2±0.2 <sup>d</sup> | 1.9±0.1 <sup>c</sup> | 2.5±0.7 <sup>a</sup> | 13.1±0.2 <sup>b</sup> | 56.5±1.1 <sup>c</sup> |
| WF : AF     |                       |                       |                      |                      |                       |                       |
| E= 40:60    | 7.7±1.0 <sup>a</sup>  | 20.2±0.2 <sup>e</sup> | 3.7±0.1 <sup>d</sup> | 3.5±0.7 <sup>a</sup> | 16.9±0.3 <sup>c</sup> | 48.1±0.1 <sup>a</sup> |
| WF : AF     |                       |                       |                      |                      |                       |                       |

Means in column with different superscripts are significantly different ( $P < 0.05$ )

WF=Wheat flour; AF=Ackee flour.

The fat, fibre and protein contents increased with increasing level of ackee aril flour substitution indicating nutrients enhancement with ackee aril flour substitution ranging from 2.1, 0.5 and 10.2 % (0 % ackee aril flour substitution) to 20.2, 3.7 and 16.9 % (60 % ackee aril substitution) respectively. This could obviously be due to the significant quantity of protein in ackee fruit [13]. This high protein content in wheat ackee aril mixes will be of nutritional importance in most developing countries, Ghana inclusive where many people can hardly afford high proteinous foods because of the cost. The moisture, fat and fibre contents as shown in Table 2 also assumed the same trend as the protein content due to the same reason while carbohydrate decreased with increasing level of ackee aril flour substitution supporting the claims of Abioye *et al.* [14].

### 3.3. Sensory Evaluation of the Chips Sample

The results from sensory evaluation (Table 3) showed that all chips samples were generally accepted for all attributes evaluated as none scored below the minimum acceptable rating of 5 on the 9 point hedonic scale.

**Table 3. Sensory evaluation scores of chips samples produced from blends of wheat and ackee aril flour**

| Quality attributes    | A                 | B                  | C                  | D                 | E                  |
|-----------------------|-------------------|--------------------|--------------------|-------------------|--------------------|
| Appearance            | 6.88 <sup>b</sup> | 6.46 <sup>a</sup>  | 6.40 <sup>a</sup>  | 6.30 <sup>a</sup> | 6.60 <sup>ab</sup> |
| Taste                 | 6.80 <sup>c</sup> | 6.12 <sup>b</sup>  | 6.08 <sup>b</sup>  | 5.38 <sup>a</sup> | 6.02 <sup>b</sup>  |
| Texture               | 6.86 <sup>b</sup> | 6.65 <sup>ab</sup> | 6.74 <sup>ab</sup> | 6.44 <sup>a</sup> | 6.66 <sup>ab</sup> |
| Mouth feel            | 7.02 <sup>c</sup> | 6.36 <sup>b</sup>  | 6.34 <sup>b</sup>  | 5.72 <sup>a</sup> | 6.36 <sup>b</sup>  |
| Aroma                 | 6.58 <sup>a</sup> | 6.30 <sup>a</sup>  | 6.52 <sup>a</sup>  | 6.52 <sup>a</sup> | 6.70 <sup>a</sup>  |
| Overall acceptability | 7.28 <sup>c</sup> | 6.64 <sup>b</sup>  | 6.72 <sup>b</sup>  | 6.18 <sup>a</sup> | 6.68 <sup>b</sup>  |

Sample with mean values bearing the same letter of superscript in the same row are not significantly different ( $p \geq 0.05$ ). Samples: A: 100% wheat flour, B: 80% wheat flour and 20% ackee aril flour, C: 60% wheat flour and 40% ackee aril flour, D: 50% wheat flour and 50% ackee aril flour, E: 40% wheat flour and 60% ackee aril flour.

Appearance or colour by physical examination ranged from 6.30 - 6.88 for chips while taste score ranged from 5.38 - 6.80 in chips. Texture, mouth feel and aroma score ranged from 6.44 - 6.86, 5.72 - 7.02 and 6.30 - 6.70 respectively. Where there was equal mixes of wheat-ackee aril flour (50% WF: 50% AF) resulted in chips scoring lower value for all the sensory attributes tested with the exception of aroma. The control sample score a high value for all the sensory attributes examined with the exception of sample E which score 6.70 for aroma although this was not significantly different from the control.



**Plate 1.** Pictures showing chips samples of wheat-ackee aril flour blend

The results of sensory evaluations reveal that chips produced from ratio 100:0 wheat-ackee aril composite flour are significantly different ( $p \leq 0.05$ ) in appearance from chips made from ratios 80:20, 60:40 and 50:50

wheat-ackee aril composite flour, but there was not significantly different ( $p \geq 0.05$ ) from 40:60 wheat-ackee aril composite flour (Table 3). However, as the percentage substitution of ackee aril increases in the wheat-ackee aril flour blend for chips making, the colour also changed gradually making sample E (40% WF: 60% AF) darker than the rest of the samples as shown in Plate 1.

A drop in taste was observed as the level of wheat flour was substituted with ackee aril flour. Chips from wheat flour substituted with ackee aril flour up to 20% down to 60% reduced the taste of the chips sample significantly. However, sample B, C and E were not significantly different from each other with the exception of sample D which recorded a lower value of 5.38 and was significantly different from all the other samples.

The values obtained for aroma of all the tested samples showed no significant difference which shows a high level of acceptance of the wheat-ackee aril chips by the panellists. There was no significant difference between sample A, B, C and E for the texture of chips as ackee aril flour substitute increases.

At 20% level of substitution of ackee aril flour for wheat flour, acceptance chips were obtained. However, chips produced with 20% ackee aril flour in the mixture had overall acceptability score of 6.64 which was not significantly different from the 40% and 60% level of substitution with a total score of 6.72 and 6.68 respectively. All the same, the control had a total score of 7.28 and significantly different from chips with 20%, 40%, 50% and 60% ackee aril flour in the mixtures.

Generally, closeness of values obtained for all wheat-ackee aril chips samples to the control sample indicate a high level of acceptance of the wheat-ackee aril chips, thereby improving the nutritional contents of chips as well as increasing the utilization of ackee fruit.

## 4. Conclusion

Apart from ackee aril being processed into paste, findings in this study have shown the potential for the production of bakery products such as cake and chips. Substitution of wheat flour with ackee aril flour for chips making at levels of 20% to 60% resulted in notable increase in proximate composition. Protein, fat and fibre of the flour blends increased with increasing ackee aril flour contents while carbohydrate decreased simultaneously. The experiments produced chips of acceptable sensory qualities from all ratios of wheat-ackee aril flour that was used; therefore, these research findings have unveiled new windows for further utilization of ackee aril.

## Statement of Competing Interests

The authors have no competing interests.

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