

Production and Evaluation of the Proximate and Mineral Composition of Chin-Chin from Blends of Wheat and Jackfruit Seed Flours

Echem Franklyn Nduka

Food Science and Technology, Federal Polytechnic Oko, Orumba North, Anambra State.

Corresponding author: echemfranklyn@gmail.com

Abstract

Chin-chins were produced from blends of wheat flour and jackfruit seed flour with the aim of determining its proximate and mineral composition as well as their sensory acceptability. Jackfruit seeds were processed into flour. Wheat flour was blended with the jackfruit flours in the ratios of, 80:20, 60:40, 50:50 and 100:0 which were labeled as AAA, BBB, CCC and DDD, respectively. These flour samples were used to produce Chin-chin and the proximate and mineral composition and sensory qualities of the Chin-chin were determined. The moisture, ash, protein, fat, fibre and carbohydrate content of the Chin-chin ranged from 12.20 – 13.03%, 5.00 – 10.00%, 9.10 – 14.50%, 6.33 – 7.00%, 12.73 – 13.35% and 42.92 – 53.00 respectively. The results showed that the Chin-chin had mineral values ranging from 482.28 – 861.72mg/100g for calcium, 151.50 – 210.40mg/100g for magnesium, 65.30 – 68.60mg/100g for potassium, 5.33 – 13.50mg/100g for iron and 121.30 – 147.60mg/100g for phosphorus. It was observed that incorporation of jackfruit seed flour had significant effect on the proximate and mineral composition of the Chin-chin. The sensory evaluation results of the Chin-chin showed that the degree of likeness of the Chin-chin decreased significantly as the level of substitution of wheat flour with jackfruit seed flour increased. However, samples AAA and BBB which had overall acceptability scores of 6.83 and 6.60 respectively competed favourably with the control sample which had a score of 7.57. The study has shown the possibility of producing snacks from wheat-jackfruit seed flour blends.

Keywords: Chin-chin, Jackfruit Seeds, Proximate Composition, Sensory Evaluation and Production.

Introduction

Chin-chin is a fried or baked snack which is popular across Nigeria and other parts of West Africa (Adegunwa *et al.*, 2014). It is a sweet, doughnut-like product prepared primarily from wheat flour, butter, eggs and milk. This is made into a stiff paste, rolled, cut and shaped into inches and then fried using vegetable oil or baked until it is golden brown and crispy (Kehinde *et al.*, 2017). Wheat is a major cereal crop in many parts of the world, which belongs to the *Triticum* family of which there are many thousands of species, with soft wheat (*T. aestivum*) and the hard wheat (*Triticum durum*) being the most important commercially (Inyang *et al.*, 2018). As stated in the study of Bello *et al.*, (2020) wheat contains 78.10% carbohydrate, 14.70% protein, 2.10% fat, 2.10% minerals and considerable proportions of vitamins (thiamine and vitamin-B) and minerals. It is nutritious, easy to store

and transport and can be processed into various types of food. Wheat is the most popular energy grain for the production of confectionery products, because of the unique properties of its protein (gluten), which combines strength and elasticity required to produce bread, cookies, cakes and pastries of desirable texture and flavor (Eke-Ejiofor and Saliu, 2020).

Jackfruit (*Artocarpus heterophyllus* Lam) is the largest known edible fruit in the world. It belongs to the family Moraceae which originated in India and Malaysia and is currently found in many parts of Asia, South America, and Africa (Amadi *et al.*, 2018). The fruit consists of edible bulbs of yellow-flesh, rind and seeds. According to Ogbuonye (2018), the succulent, aromatic, and flavorful fruit is eaten fresh or preserved in myriad way. The nutritious seeds are boiled or roasted and eaten like chestnuts, added to flour for baking, or cooked in dishes. Jackfruit seed that represents 15–18% of the fruit weight is a good source of proteins, fibres, starch and many minerals such as potassium, phosphorus, calcium, magnesium, zinc, and copper (Zuwariah *et al.*, 2018; Waghmare *et al.*, 2019). Furthermore, the seeds have various health benefits to human beings such as anti-inflammatory, antioxidant, antiulcer, and anti-diabetic activities, which are linked to the phytochemicals and other bioactive compounds present in them (Adan *et al.*, 2020, Sreeja-Devi *et al.*, 2021). However, despite their high nutritional value and health benefits, jackfruit is still underutilized and highly perishable due to insufficient processing knowledge and resources in the regions where it is grown (Ngwere and Mongi, 2021). The seeds are discarded as waste because their potentials as food ingredients have not been fully explored by food industries. According to Adan *et al.* (2020) and Ngwere and Mongi (2021), the seeds may be processed into flour and incorporated into wheat flour to produce composite bakery products and confectioneries like cake, bread, chin-chin and buns.

In Nigeria, the increase in demand for snacks especially ready-to-eat baked products and confectioneries made from wheat flour is encouraging massive importation of wheat from European countries (Ocheme *et al.*, 2018). This development is pushing the prices of wheat-based products available in the markets above the reach of many Nigerians. In a bid to reverse the trend, supplementing wheat flour with non-wheat flour made from indigenous and affordable crops is aimed at increasing the yield of locally grown crops and reduce the level of wheat importation (Nwanekezi, 2013). Flour processed from a single crop could be deficient in some essential nutrients, not able to meet the nutritional needs of individuals facing health challenges such as obesity, diabetes and heart-related diseases. Some of these limitations could be addressed using composite flour which also offers economic benefits. Thus, several studies on composite flours have been carried out. Yet, more studies are still required for continuous improvements (Peter-Ikechukwu *et al.*, 2017).

Despite adequate information on the nutritional composition of jackfruit seeds, its use in formulation of composite flours for production of chin-chin has not been documented. It is expected that the inclusion of jackfruit into wheat flour will result in product with enhanced nutritional values and their consumption in the right amounts may improve nutrition outcomes of people in the society. This study is therefore aimed at evaluating the proximate and mineral composition as well as sensory acceptability of chin-chin produced from blends of wheat and jackfruit seed flours.

Materials and Methods

Source of Material

Two matured and ripe jackfruit, wheat flour and other pastry materials such as butter, baking powder, egg, flavour, sugar etc were purchased from Eke Ekwuluobia market in Aguata Local Government Area of Anambra State and were taken to the Food Processing Laboratory of Department of Food Technology, Federal Polytechnic Oko for further processing.

Processing of Jackfruit Seed Flour

The method described in the study of Palamthodi *et al.* (2020) was adopted in processing the jackfruit seed into flour. The fresh jackfruits were cut open and the seeds were collected. The seeds were obtained, cleaned and the seed coats were manually removed. The thin brown spermoderm which covers the cotyledon were also removed by rubbing the seeds in between the palm. The peeled seeds were then sliced into thin chips and dried at 80°C in a cabinet dryer for 10 hrs. The dried seeds were powdered in a grinder, sieved and packed in airtight container prior to further use.

Formulation of Composite Flours

Composite flours were formulated from all purpose wheat flour and jackfruit seed flour in the ratios of 80:20, 50:50, 20:80 and 100:0 respectively.

Production of Chin-Chin

The method described in the study of Eke-Ejiofor and Allen (2019) was adopted for the production of wheat-jackfruit seed chin-chin. The composite flour, sugar, butter, egg, flavour, baking powder, water, and milk were mixed together at appropriate quantities in a bowl until a dough was formed. The dough was placed on a wood surface and kneaded until smooth and elastic. The kneaded dough was rolled out to approximately 2cm thickness and then cut into small squares (2cm by 2cm size). Dough was fried using a deep fryer at about 180°C for about 8minutes until golden brown colour was achieved. The fried chin-chin was removed and drained of excess oil. The samples were allowed to cool before they were packaged in labeled airtight containers until needed for analysis.

Proximate Analysis

The proximate (moisture, ash, crude protein, crude fibre, crude fat and carbohydrate) composition of the chin-chin sample was determined using the standard methods of AOAC (2012).

Mineral Analysis

The mineral composition of the samples was determined using AOAC (2012) methods. A fraction of 0.3g of each sample was wet digested in a 50ml beaker using 30ml of HNO₃-

HClO₄ acid solution (2:1 volume) on a hot digestion system to obtain a colourless solution after heating. At the completion of digestion, the solution of each sample was transferred into a 50ml calibrated sample bottle and the solution was diluted to the mark with distilled water. Calcium (Ca), Magnesium (Mg), Iron (Fe) and Phosphorus (P) in the samples were determined by flame atomic absorption spectrophotometer. Potassium (K) in the samples was determined by flame photometer using a working standard of 10ppm for each of the species.

Sensory Evaluation

The chin-chin prepared from wheat flour and the composite flour were subjected to sensory evaluation and this was done by coding all the samples and serving them to ten panelists that were familiar with assessment of pastry products. The samples were evaluated for sensory parameters which are texture, taste, colour, flavour and general acceptability using the scoring text as described by Iwe (2014). The responses were scored on a nine point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely). Panelists were told to rinse their mouth with potable water in between tasting.

Statistical Analysis

All analysis was carried out in triplicates for all determinations and the results were expressed as mean of the triplicate determination. The SPSS 25.0 for windows computer software package was used for one way analysis of variance (ANOVA). The difference in means was compared by using the Duncan's multiple range tests.

Results and Discussion

The result of the proximate composition of chin-chin produced from blends of wheat flour and jackfruit seed flour is shown in Table 1. The moisture content of the samples ranged from 12.20% to 13.03%. The highest moisture content was recorded for sample DDD while the least moisture content was recorded for sample AAA. The results revealed that incorporation of jackfruit seed flour slightly reduced the moisture content of the chin-chin. The values recorded for moisture in this study fell within the range (10.66 – 19.70%) reported by Amadi and Ezenwa (2019) for wheat-fermented jackfruit seeds cookies but higher than 4.80 – 5.60% reported by Islam *et al.* (2015). Their studies however, noted that addition of jackfruit seed flour significantly increased the moisture contents of the baked products which is contrary to the findings of the present study. The varied observations could be due to different processing and formulation method adopted. The moisture content estimates directly the water content and indirectly the dry matter of the samples. High-moisture products (>12%) usually have shorter shelf stability compared with lower-moisture products (<12%), as reported by Eke-Ejiofor and Deedam (2015). Therefore, the low moisture content of all the chin-chin samples makes them less liable to microbial attack.

The ash content of the samples ranged from 5.00% to 10.00% with samples DDD having the least value while sample CCC had the highest value. The results showed that significant

differences ($p < 0.05$) existed amongst the samples in the ash content. It was observed that addition of jackfruit seed flour improved the ash value of the samples as the level of substitution of wheat flour increased. Ngwere and Mongi (2021) reported that inclusion of jackfruit seed flour increased the ash content (0.30 – 1.50%) of wheat buns. According to Bolarinwa *et al.* (2017), ash content describes the index of the mineral content of food. The increment in the ash content of the snack samples could probably mean that they will be rich in mineral elements needed for body's metabolic processes.

Table 1: Proximate composition (%) of chin-chin produced from the blends of wheat and jackfruit seed flours

Samples	Moisture	Ash	Protein	Fat	Fibre	Carbohydrates
AAA	12.20 ^c ±0.14	8.10 ^c ±0.01	9.80 ^c ±0.13	6.70 ^a ±0.01	12.80 ^c ±0.07	50.17 ^b ±0.03
BBB	12.60 ^b ±0.03	8.93 ^b ±0.04	11.03 ^b ±0.02	6.50 ^a ±0.01	13.10 ^b ±0.00	47.93 ^c ±0.02
CCC	12.80 ^b ±0.10	10.00 ^a ±0.00	14.50 ^a ±0.02	6.33 ^a ±0.02	13.35 ^a ±0.11	42.92 ^d ±0.05
DDD	13.03 ^a ±0.02	5.00 ^d ±0.00	9.10 ^d ±0.17	7.00 ^a ±0.00	12.73 ^c ±0.01	53.00 ^a ±0.00

*Values are means ± standard deviation of triplicate determination. Means with the same superscript in the same column are not significantly different ($p < 0.05$). **Keys:** AAA = 80:20 Wheat-Jackfruit Seed Flour; BBB = 50:50 Wheat-Jackfruit Seed Flour; CCC = 20:80 Wheat-Jackfruit Seed Flour; DDD = 100:0 Wheat-Jackfruit Seed Flour.

There was similar increase in the protein content of the formulated snacks as the level of inclusion of jackfruit seed flour increased. The percentage protein content of the samples significantly ($p < 0.05$) increased from 9.10% in the control sample (DDD) to 14.50% in the sample containing 80% of jackfruit seed flour (CCC). Amadi and Ezenwa (2019) reported similar increase in the protein (15.15 – 18.97%) content of cookies produced from wheat-fermented jackfruit seed. This result is also in agreement with the report of Adebayo-Oyetoro *et al.* (2017) observed a marked increase in the protein content of chin-chin with increasing level of substitution of wheat flour with tiger nut flour. This increase in the protein content of the snacks suggests that the incorporation of jackfruit seed flour into staple foods in Nigeria which majorly comprises of cereals and starchy roots and tubers could be of importance in meeting the protein requirements of individuals.

There was no significant increase ($p > 0.05$) in the fat content of the products although there was slight decrease in the numerical values as the level of inclusion of jackfruit seed flour in wheat flour increased. The sample produced with 80% jackfruit seed flour and 20% wheat flour (CCC) had the least fat content of 6.33% while the control sample (DDD) had the highest fat content of 7.00%. This observation is contrary to the findings of Islam *et al.* (2015) who noted an increase in the fat content (21.50 – 30.50%) of biscuits as the level of addition of jackfruit seed flour increased. The contrary results could be due to differences in the composition of the raw materials. The observed decrease in fat content in composite

chin-chin may be attributed to low fat contents (4.29%) in jackfruit seed flour (Amadi *et al.*, 2018).

The fibre content of jackfruit seed flour-wheat flour chin-chin studied increased from 12.73% to 13.35% with an increase in the added jackfruit seed flour. There was no significant difference ($p>0.05$) in the fibre content of samples DDD and AAA but they differed significantly ($p<0.05$) from other samples. Similar increase in the fibre content was reported by Ngwere and Mongi (2021) for buns produced from composite flours of wheat and jackfruit seeds although their values (1.50 – 2.90%) are lower when compared with the ones obtained in the present study. Dietary fibre, the indigestible cell wall component of plant materials could play an important role in human health. Previous study on low dietary fibre intakes in developed countries have been linked to several Western diseases. Epidemiological studies have shown that high dietary fibre intake helps to prevent or treat hyperlipidemia. Also linked with high dietary fibre is the prevention of cardiovascular disease, hypertension, obesity, gastrointestinal disorders and diabetes (Ayo and Ayo, 2018).

The percentage composition of carbohydrate in the snacks samples showed values ranging from 42.92% - 53.00% with sample CCC having the highest value while sample DDD had least value. The carbohydrate content of the samples was found to decrease as the ratio of wheat flour decreases. There were significant differences in the carbohydrate contents of the samples. The findings are similar to that of Amadi and Ezenwa (2019), and Ngwere and Mongi (2021).

Table 2 shows the mineral composition of chin-chin produced from blends wheat flour and jackfruit seed flour. The results revealed a significant increase in the calcium content of the products fortified with jackfruit seed flour when compared to that of the control sample. The calcium content of the samples ranged from 482.28mg/100g in sample DDD to 861.72mg/100g in sample CCC. A significant difference ($p<0.05$) was observed in the calcium content of the samples. These values are higher than 20.00 – 48.00mg/100g reported for wheat-jackfruit cookies (Amadi and Ezenwa, 2019). Calcium has been implicated in its role in rickets, osteoporosis and osteomalacia, and even in most metabolic processes in the body (Amadi *et al.*, 2018). Thus, the increased calcium content of the snack samples would be an advantage especially for children who need calcium for growth and development of their bones and teeth.

Table 2: Mineral composition (mg/100g) of chin-chin produced from the blends of wheat and jackfruit seed flours

Samples	Calcium	Magnesium	Potassium	Iron	Phosphorus
AAA	717.40 ^c ±0.40	156.60 ^c ±0.01	66.65 ^b ±0.06	6.80 ^c ±0.07	125.00 ^c ±0.00
BBB	761.52 ^b ±0.13	184.00 ^b ±0.00	66.00 ^c ±0.00	11.75 ^b ±0.13	129.50 ^b ±0.08
CCC	861.72 ^a ±0.06	210.40 ^a ±0.03	65.30 ^d ±0.01	13.50 ^a ±0.02	147.60 ^a ±0.01
DDD	482.28 ^d ±0.20	151.50 ^d ±0.05	68.60 ^a ±0.15	5.30 ^d ±0.04	121.30 ^d ±0.31

*Values are means $\pm$ standard deviation of triplicate determination. Means with the same superscript in the same column are not significantly different ($p < 0.05$).

Keys: AAA = 80:20 Wheat-Jackfruit Seed Flour; BBB = 50:50 Wheat-Jackfruit Seed Flour; CCC = 20:80 Wheat-Jackfruit Seed Flour; DDD = 100:0 Wheat-Jackfruit Seed Flour.

The magnesium content of the samples ranged from 151.50 – 210.40mg/100g. Sample CCC had the highest magnesium content while sample DDD had the least value. There was significant difference ($p < 0.05$) in the magnesium content of the samples. It was observed that inclusion of jackfruit seed flour in the formulated chin-chin increased the magnesium content of the products. These values are however higher than 40.00 - 60.00 mg/100g reported by Ngwere and Mongi (2021) for buns produced from composite flours of wheat and jackfruit seed flour. The variations in these results could be due to the differences in the raw materials. According to Talabi *et al.* (2019), magnesium and calcium works hand in hand and their under-absorption may lead to problems such as arthritis, osteoporosis, menstrual cramps, and some premenstrual symptoms.

The results in Table 2 revealed a decreased potassium content in the chin-chin samples as the level of replacement of wheat flour with jackfruit seed flour increased. The potassium content ranged from 65.30mg/100g in sample CCC to 68.60mg/100g in sample DDD with slight significant difference ($p < 0.05$) existing amongst them. Potassium is an essential nutrient needed for the maintenance of total body fluid volume, acid and electrolyte regulation, nerve function, muscle control, and blood pressure (Weaver, 2013).

The iron and phosphorus content of the snack samples ranged from 5.30 – 11.50mg/100g and 121.30 – 147.60mg/100g respectively. There was significant difference ($p < 0.05$) in their values. The results showed that addition of jackfruit seed flour significantly improved the iron and phosphorus content of the samples. Iron is involved in energy metabolism as an oxygen carrier in hemoglobin, and its deficiency leads to anaemia and impaired ATP synthesis (Amadi *et al.*, 2018) while phosphorus is an essential mineral primarily used for growth and repair of body cells and tissue. Phosphorus together with calcium provides structure and strength. Phosphorus is also required for a variety of biochemical processes including energy production and regulation (Odimegwu *et al.*, 2019). Jackfruit flour has been reported to be rich in minerals than wheat flour (Abedin *et al.* 2012) which could be the reason for the progressive increase in mineral contents in the composite chin-chin. The high amounts of minerals in composite chin-chin are very important in the human diet and normal body health.

The mean scores for the sensory evaluation of chin-chin produced from the blends for wheat flour and jackfruit seed flour is presented in Table 3. There was significant difference ($p > 0.05$) in the colour attribute of the samples. The mean scores for colour ranged from 6.60 in sample CCC to 8.80 in sample DDD. This indicates that the colours of the whole samples were accepted by the panelist although there was a slight decrease in the mean values as the level of substitution of wheat flour with jackfruit seed flour increased. A similar study by

Amadi and Ezenwa (2019) revealed that inclusion of jackfruit seed flour in cookies slightly affected the colour of the sample. This is in line with the observation of this study.

Table 3: Sensory qualities of chin-chin produced from the blends of wheat and jackfruit seed flours

Samples	Colour	Taste	Texture	Aroma	Overall Acceptability
AAA	8.00 ^b ±0.47	8.20 ^{ab} ±0.79	7.90 ^b ±0.74	8.00 ^b ±0.82	8.02 ^b ±0.45
BBB	8.40 ^{ab} ±0.84	7.70 ^b ±0.67	7.20 ^c ±0.63	7.90 ^b ±0.57	7.83 ^b ±0.59
CCC	6.60 ^c ±0.97	6.80 ^c ±1.03	6.10 ^d ±0.99	6.10 ^c ±1.10	6.40 ^c ±0.97
DDD	8.80 ^a ±0.42	8.80 ^a ±0.42	8.80 ^a ±0.52	8.80 ^a ±0.61	8.80 ^a ±0.35

*Values are means ± standard deviation. Means with the same superscript in the same column are not significantly different ($p < 0.05$). **Keys:** AAA = 80:20 Wheat-Jackfruit Seed Flour; BBB = 50:50 Wheat-Jackfruit Seed Flour; CCC = 20:80 Wheat-Jackfruit Seed Flour; DDD = 100:0 Wheat-Jackfruit Seed Flour.

The mean score for the taste for the product ranged from 6.80 to 8.80. The control sample (DDD) was the most accepted in terms of taste while the sample produced from 20% wheat flour and 80% jackfruit seed flour (CCC) was the least accepted. There was significant difference ($p < 0.05$) in the taste of samples.

The texture score ranged from 6.10 - 8.80. 100 %Wheat chin-chin had the highest score while the samples produced from 20% wheat flour and 80% jackfruit seed flour had the lowest score of likeness in terms of texture. The result revealed that the control sample significantly varied ($p < 0.05$) from the rest of the samples. The findings of Adegunwa *et al.* (2014) recorded similar decrease in texture acceptance of chin-chin as the level of substitution of wheat flour with millet flour increased.

The aroma of the samples significantly differed ($p < 0.05$) except for samples AAA and BBB which were not significantly different ($p > 0.05$) from one another. The mean score for aroma ranged from 6.10 in sample CCC to 8.80 in sample DDD. Aroma is the main criterion that makes the product to be liked or disliked. This result concurred with the findings of Amadi and Ezenwa (2019) who also reported a decreased level of acceptance of the aroma of cookies produced from wheat and jackfruit seed flour.

The overall acceptability scores of the snacks showed that the control sample (DDD) was the most preferred (8.80) and it significantly differed ($p < 0.05$) from the rest of the samples which ranged from 6.40 in sample CCC to 8.02 in sample AAA. This indicates that the samples fortified with jackfruit seed flour were acceptable and they competed favourably with the control sample.

Conclusion

This study has established that good quality and acceptable chin-chin can be produced from blends of wheat flour and jackfruit seeds flour. The findings of the study revealed that

addition of jackfruit seeds flour improved the proximate and mineral composition of the snack without adversely affecting the sensory attributes. Production of snacks with indigenous crop like jackfruit seed would enhance its utilization and enhance value addition in production chain.

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