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Physicochemical properties of chin-chin produced from wheat and chicken flour blends

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ABSTRACT

This study was carried out to determine the nutritional composition of snacks (chin-chin) produced from blends of wheat flour and chicken meat flour. The chicken flour was blended with the wheat flour in the ratio of 0:100, 50:50, 60:40 and 40:60 to obtain samples WWW, WWC, CHC and CHW respectively. These flour blends was used to produce chin-chin which was subjected to sensory, proximate analysis and mineral analysis using standard methods. The results revealed that significant differences existed amongst the proximate and mineral parameters. The moisture content ranged from 2.00% in CHW to 4.00% in WWW. There was a significant increase in the fat (10.00 – 15.00%), ash (2.00 – 7.00%) and protein (18.90 – 32.81%) content of the samples fortified with wheat flour. However, the fibre and carbohydrate content of the samples decreased from 7.50% in WWW to 5.00% in all the fortified samples and 57.60% in WWW to 36.19% in WWC. The magnesium, phosphorus, potassium and sodium content of the samples increased in the fortified samples while the calcium content decreased. There was no significant difference ($p>0.05$) in the colour and texture of the samples but the taste, flavour, crispiness and overall acceptability of the fortified samples varied significantly ($p<0.05$) from the control sample (WWW). The overall acceptability results of the samples showed that the control sample was the most accepted with a score of 7.66 closely followed by the sample containing 50% chicken meat flour (CHC) which had a mean score of 6.48. The result of this study has shown that acceptable snacks with improved nutritional values can be processed from blends wheat flour and chicken meat flour.

Keywords: snacks (chin-chin), chicken flour, proximate analysis, nutritional values

1. INTRODUCTION

Snacks are ready-to-eat foods consumed primarily for pleasure rather than for social or nutritive purpose and not ordinarily used in a regular meal [1]. These snacks are often prepared from wheat flour and in some cases as composite with other cereal or legume flour. The snacks commonly consumed include cake, chin-chin, doughnut, buns, cookies, meat pie, among others [2].

Snack foods are consumed all over the world on a large scale in developing countries where protein energy-malnutrition is prevalent [3]. Malnutrition is the insufficient, excessive or imbalanced consumption of nutrients [4]. The World Health Organization cites malnutrition as the gravest single threat to the world's public health. A number of different nutritional disorders such as celiac disease, diabetes and coronary heart diseases may arise, depending on which nutrients are under or over abundant as a result of increase in consumption of these confectionary products. This led to the current trend in nutrition which is the consumption of functional foods advocated by World Nutrition Bodies due to these health related problems with wheat flour consumption [5]. This situation has created the need for the consumption of high-protein, low-carbohydrate diets, slowly digested starchy foods as well as an increased intake of functional foods [6]. Based on this, snack products with functional ingredients have been reported by different scientist from the blends of wheat/soybean [7], wheat/full fat soya [8]; wheat/cashew-apple residue [9], plantain/Bambara groundnut protein concentrate [10] and blend of Moringa leaf powder/wheat flour [11]. There is need for production and formulation of snacks that are both nutritious and enjoyable to consume hence the aim of this work is to determine the nutritional qualities of high protein snacks produced from blends of wheat and dried chicken powder.

2. MATERIALS AND METHODS

2.1. Sample collection

The chicken meat, wheat flour and other pastry materials such as butter, baking powder, egg, vanilla flavour, sugar etc were purchased from Eke Oko market in Orumba North 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 and analysis.

2.2. Sample Preparation

2.2.1. Production of Chicken Flour

Chicken flour was produced according to the method described by Ilansuriyan *et al.*, [12] with slight modification. Two kilograms of chicken meat was thoroughly washed with clean water. The meat was chopped and cooked for 25 mins after which the cooking water was drained. The cooked meat was dried using a cabinet dryer at 80 °C for 24 hrs. The dried meat was milled, sieved and packaged in a clean plastic container prior to further use.

Table 1: Composition of the Flour

Sample	Wheat Flour	Chicken powder flou
A	100	0
B	50	50
C	60	40
D	40	60

2.2.2. Formulations of Wheat-Chicken Powder Composite Flour

Wheat flour was mixed with chicken powder at varying proportions as shown in the Table 1.

2.2.3. Production of Snacks

The composite flour, sugar, butter, egg, baking powder, water, and milk were mixed together at appropriate quantities in a bowl. The dough was placed on a work surface and kneaded until smooth and elastic. The kneaded dough was rolled out to approximately 2cm thickness and then cut into small squares. Dough was fried using a deep fryer at about 180°C for about 8 minutes until golden brown. The fried chin-chin was removed and drained of excess oil before serving [13].

2.3. Proximate Analysis

The proximate analysis of the samples was carried out using the analytical methods of AOAC (2019) [14].

2.3.1. Moisture Content Determination

Five grams sample in the can was dried in the moisture extractor at 105 °C for 3 hours. It was cooled in a dessicator and weighed and was returned to the oven for further drying. Drying, cooling and weighing was done repeatedly at an hour interval until there was no further diminutions in the weight (i.e. a constant weight was obtained). The weight of moisture loss was calculated and expressed as a percentage of the weight of sample analysed (eq 1).

$$\% \text{ moisture content} = \frac{W_2 - W_3}{W_2 - W_1} \times 100\% \qquad \text{...eq 1}$$

Where,
W_1 = Weight of empty can
W_2 = Weight of empty can + sample before drying
W_3 = Weight of can + sample dried to a constant weight

2.3.2. Ash Content Determination

10g of sample were dried in the moisture extraction oven until constant weights was obtained. Then, the sample was burnt to ashes in a muffle furnace at 550 °C. When completely ashed, it was cooled in a desiccator and weighed. The weight of ash obtained was calculated by difference and expressed as a percentage of the weight of sample analysed (eq. 2).

$$\% \text{ Ash content} = \frac{W_2 - W_1 \times 100\%}{\text{Weight of sample}} \qquad \text{...eq. 2}$$

Where,
W_1 = weight of empty crucible
W_2 = weight of crucible + Ash

2.3.3. Crude Fibre Determination

Two grams of the sample was boiled in 150 mls of 1.25% H_2SO_4 solution for 30 minutes under some conditions. After washing in several portion of hot water, the sample was allowed to drain and dry before being transferred quantitatively to a weighed crucible where it was dried in the oven at 105 °C to a constant weight. It was thereafter taken to a muffle furnace where it was burnt until only ash was left of it by difference; the weight of fiber was obtained and expressed as a percentage of weight of sample analysed (eq. 3).

Calculation:

$$\% \text{ crude fibre} = \frac{W_2 - W_3 \times 100\%}{\text{Weight of sample}} \qquad \text{...eq. 3}$$

Where,
W_2 = weight of crucible + sample after boiling, washing and drying.
W_3 = weight of crucible + sample ashing

2.3.4. Fat Determination

Ten grams (10g) of the sample was weighed into a thimble carefully and put in the sample holder of the soxhlet extraction apparatus. A clean dried and weighed soxhlet extraction flask was filled with 250 ml of N hexane and the whole apparatus was assembled together, and the flask placed on the heating mantle and heated at 68 °C. The fat was extracted for three hours. The drying, cooling and re-weighing of the sample was repeated until a constant weight is obtained. The percentage fat contained was determined thus;

$$\% \text{ fat} = W_2 - W_3 \times 100\% \qquad \text{...eq. 4}$$

Where,
W_1 = weight of empty filter paper
W_2 = Weight of paper + sample before defatting
W_3 = weight of paper + sample after defatting

2.3.5. Crude Protein Determination

This was done according to the method described by AOAC (2019) [14]. The total nitrogen was determined and multiplied with factor 6.25 to obtain the protein content. Half gram (0.5g) of the sample was mixed with 10ml of concentrated H_2SO_4 in a digestion flask. A tablet of 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 100ml in a volumetric flask and used for the analysis. 10ml of the digest was mixed with equal volume of 45% NaOH solution in a Kjeldahl distillation into 10ml of 4% buric acid containing three drops of mixed indicator (bromocressol green/methyl red). A total of 50ml of distillates was collected and titrated against 0.02N EDTA from green to a deep red end point. A reagent blank was also digested, distilled and titrated. The nitrogen and protein content was calculated using the equation 5

% protein = % N_2 x 6.25

Therefore:

$$\% N_2 = \frac{100}{10} \times \frac{N \times 14 \times V_t}{1000} \; \frac{T-B}{V_a} \qquad ...eq.\ 5$$

Where,

W = Weight of sample (0.5g)

V_t = Total digest volume (100ml)

V_a = Volume of digest analysed (10ml)

T = Sample titre value

B = Blank titre value

2.3.6. Carbohydrate Determination

Carbohydrate content was by difference. It was calculated using the equation 6:

%carbohydrate = 100 - % (moisture + protein + ash + fibre + fat) *...eq. 6*

2.3.7. Mineral Analysis

The mineral composition of the samples was determined as described in the study of Ndife *et al*. (2014). A fraction of 0.3g of each of the paste-like sample was wet digested in a 50ml beaker using 30ml of HNO_3-$HClO_4$ 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 Zinc (Zn) in the samples were determined by flame atomic absorption spectrophotometer. Sodium (Na) and Potassium (K) in the samples were determined by flame photometer using a working standard of 10ppm for each of the species.

2.4. 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 twenty panelists that were familiar with assessment of bakery 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 (2002) [15]. The responses were scored on a nine point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely).

2.5. 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 21.0 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.

3. RESULTS AND DISCUSSION

3.1. Proximate composition (%) of chin-chin produced from composite flours of wheat and chicken meat

This analysis is carried out to determine the proximate composition of the chin-chin produced from the different composition of flours. For the moisture content, the chin produced from only wheat flour (WWW) had the highest moisture content of about 4% followed by Composition of wheat and chicken meat flour at the proportion of 60:40 (CHC) at 3% and composition 50:50 composition (WWC) at 2.3% and lastly, 40:60 proportions (CHW) at 2%. For the fat, the highest fat content was seen in the composition 50:50 composition of the flour (WWC) at 15% and the lowest fat content was recorded in the 100:0 proportion of the flour (WWW). The highest ash content was found in the 40:60 composition of the flour (CHW) at 7% while the lowest was found in the 100:0 proportion of the flour (WWW) at 2%. The highest fibre content was found in the 100:0 composition of the flour

(WWW) at 7.5% while the lowest was found in the 40:60 proportion of the flour (CHW) at 5%. The highest protein content was found in the 50:50 composition of the flour (WWC) at 32.8% while the lowest was found in the

100:0 proportion of the flour (WWW) at 18%. The highest carbohydrates content was found in the 100:0 composition of the flour (WWW) at 57% while the lowest was found in the 50:50 proportion of the flour (WWC) at 36.19% (table 2).

Table 2 reveals the proximate composition of chin-chin produced from the blends of wheat and chicken meat flour. The moisture content of the snack samples were low and varied significantly ($p<0.05$). The percentage moisture content ranged from 2.00 – 4.00%. The results showed that inclusion of chicken meat flour further reduced the moisture in the snacks. These values are much lower than 8.35 - 12.85% reported by Eke-Ekejiofor and Allen for chin-chin produced from the blends of cassava and tigernut residue flour [13]. The variation in the moisture content of these samples was as a result of the differences in the raw materials used. 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 [16]. Therefore, the low moisture content of all the chin-chin samples makes them less liable to microbial attack.

There was a significant increase ($p<0.05$) in the fat content of the products as the level of inclusion of chicken flour in wheat flour increased. The sample produced with 50% chicken flour and 50% wheat flour (WWC) had the highest fat content of 15.00% while the control sample (WWW) had the least fat content. The increased fat content could be due to high fat content in chicken meat (12.56g) [17]. The relatively high fat content of the chicken meat fortified snacks indicates that the chin-chin will be more palatable, since fat increases food palatability. Eke-Ejiofor and Allen reported similar increase in the fat content of chin-chin

Table 2: Proximate composition (%) of chin-chin produced from composite flours of wheat and chicken meat

Parameters	WWW	WWC	CHC	CHW
Moisture	$4.00^{a} \pm 0.01$	$2.03^{c} \pm 0.01$	$3.00^{b} \pm 0.20$	$2.00^{c} \pm 0.00$
Fat	$10.00^{c} \pm 0.00$	$15.00^{a} \pm 0.00$	$12.00^{b} \pm 1.00$	$11.00^{bc} \pm 0.00$
Ash	$2.00^{d} \pm 0.55$	$6.00^{b} \pm 0.01$	$4.00^{c} \pm 0.05$	$7.00^{a} \pm 0.90$
Fibre	$7.50^{a} \pm 0.10$	$5.00^{b} \pm 0.00$	$5.00^{b} \pm 0.00$	$5.00^{b} \pm 0.00$
Protein	$18.90^{d} \pm 0.02$	$32.81^{a} \pm 0.01$	$27.82^{b} \pm 0.83$	$23.00^{c} \pm 0.00$
Carbohydrate	$57.60^{a} \pm 0.10$	$36.19^{d} \pm 0.01$	$48.20^{c} \pm 0.20$	$54.50^{b} \pm 0.50$

*Values are means of triplicate determinations.*Means with same superscript in the same row are not significantly different ($p<0.05$)

Table 3: Mineral composition (mg/100g) of chin-chin produced from composite flours of wheat and chicken meat

Parameters	WWW	WWC	CHC	CHW
Calcium	$103.36^{a} \pm 0.04$	$77.57^{c} \pm 0.50$	$96.05^{b} \pm 0.05$	$47.42^{d} \pm 0.02$
Magnesium	$50.10^{c} \pm 0.10$	$104.22^{a} \pm 0.01$	$90.23^{b} \pm 0.06$	$90.23^{b} \pm 0.06$
Phosphorus	$150.30^{d} \pm 0.10$	$317.88^{a} \pm 0.01$	$276.00^{b} \pm 0.00$	$288.00^{c} \pm 0.00$
Potassium	$89.64^{c} \pm 0.02$	$159.64^{a} \pm 0.55$	$108.34^{b} \pm 0.01$	$160.00^{a} \pm 0.00$
Sodium	$63.09^{d} \pm 0.02$	$120.00^{a} \pm 0.00$	$87.08^{c} \pm 0.01$	$101.68^{b} \pm 0.01$

produced from cassava and tigernut residue [13].

The ash content of the samples ranged from 2.00% to 7.00%. Significant differences ($p<0.05$) existed amongst the samples in the ash content. The results showed that addition of chicken meat flour improved the ash value of the samples. According to Bolarinwa *et al.*, ash content describes the index of the mineral content of food [18]. 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.

The fibre content of chicken meat-wheat flour chin-chin studied decreased from 7.50% to 5.00% with an increase in the added chicken flour. There was no significant difference ($p>0.05$) in the fibre content of all the fortified samples. This could be due to the fact that animal products are generally low in fibre. 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 by Anderson and Gustafson and Anderson 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 [19].

As expected, there was significant increase ($p<0.05$) in the protein content of the samples which ranged from 18.90% to 32.81%. All the samples fortified with chicken flour had high protein content compared to the control sample. Cakmak *et al.*, reported that chicken meat powder had high protein content of 78.83% [20]. The increase in the protein content of the chin-chin can be attributed to chicken flour inclusion in the blends and other ingredient like egg added in the preparation of the chin-chin dough.

There was significant difference ($p<0.05$) in the carbohydrate content of the samples which decreased as the substitution of chicken powder increased in the blend. Unfortified chin-chin sample had the highest carbohydrate content (57.60%) while 50% chicken flour fortified snack had the least carbohydrate content (36.19%). This observation was in line with other studies that also reported low level of carbohydrate content of wheat snacks fortified with moringa seed flour [19] and tiger nut flour [13].

3.2. Mineral composition (mg/100g) of chin-chin produced from composite flours of wheat and chicken meat

The mineral content analysis is the test to show the mineral composition of the chin-chin produced especially the composition of the essential minerals present hence to determine the nutritional composition of the chin-chin produced using the various flours at different proportions. The highest calcium content was found in the 100:0 composition of the flour (WWW) at 103.36% while the lowest was found in the 40:60 proportion of the flour (CHW) at 47.42%. The highest magnesium content was found in the 50:50 composition of the flour (WWC) at 104.2% while the lowest was found in the 100:0 proportion of the flour (WWW) at 50.10%. The highest phosphorus content was found in the 50:50 composition of the flour (WWC) at 317.85% while the lowest was found in the 100:0 proportion of the flour (WWW) at 150.030%. The highest potassium content was found in the 40:60 composition of the flour (CHW) at 160% while the lowest was found in the 100:0 proportion of the flour (WWW) at 89.64%. The highest sodium content was found in the 50:50 composition of the flour (WWC) at 120% while the lowest was found in the 100:0 proportion of the flour (WWW) at 63.09%. Table 3 below shows the various mineral composition of the chin-chin produced using the various proportions of the wheat and chicken flour.

Table 4: Sensory qualities of chin-chin produced from composite flour of wheat and chicken meat

Parameters	CHC	WWW	WWC	CHW
Colour	$7.10^{a} \pm 0.99$	$7.60^{a} \pm 1.26$	$6.80^{a} \pm 2.30$	$7.30^{a} \pm 1.25$
Taste	$6.80^{ab} \pm 1.03$	$7.80^{a} \pm 1.62$	$6.30^{b} \pm 1.57$	$6.00^{b} \pm 1.49$
Texture	$6.70^{a} \pm 1.16$	$7.60^{a} \pm 2.32$	$6.60^{a} \pm 0.84$	$6.60^{a} \pm 1.35$
Flavour	$6.50^{b} \pm 1.65$	$8.20^{a} \pm 1.55$	$6.50^{b} \pm 0.53$	$5.90^{b} \pm 1.37$
Crispiness	$5.90^{b} \pm 1.97$	$7.90^{a} \pm 1.37$	$6.10^{b} \pm 1.37$	$6.20^{b} \pm 1.93$
Overall Acceptability	$6.48^{b} \pm 0.93$	$7.66^{a} \pm 1.35$	$6.32^{b} \pm 0.54$	$6.28^{b} \pm 0.67$

*Means with same superscript in the same row are not significantly different (p<0.05)

Table 3 shows the mineral composition of chin-chin produced from blends wheat flour and chicken meat flour. The results revealed a decrease in the calcium content of the products fortified with chicken meat flour when compared to that of the control sample. The calcium content of the samples ranged from 47.42mg/100g in sample CHW to 103.36mg/100g in sample WWW. A significant difference (p<0.05) was observed in the calcium content of the samples.

The magnesium content of the snack bar samples ranged from 50.10mg/100g to 104.22mg/100g. There was significant difference (p<0.05) in the values obtained for magnesium although samples CHC and CHW did not differ significantly (p>0.05). Sample WWC had the highest value while sample WWW had the least magnesium content. According to Talabi *et al*., 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 [21].

The phosphorus and potassium content of the samples ranged from 150.30-317.88mg/100g and 89.64 – 160.00mg/100g respectively. Sample WWW had the least values while sample WWC had the highest values for both potassium and magnesium. The results showed a significant increase in the potassium and phosphorus content of the samples fortified with chicken flour. Potassium and phosphorus are important component of cell and body fluids that help control heart beat rate and blood pressure [19]. There was also increase in the sodium content of the samples fortified with chicken meat. A significant difference (p<0.05) existed amongst the samples. The sodium content of the samples was 63.09mg/100g, 87.08mg/100g, 101.68mg/100g and 120.00mg/100g for samples WWW, CHC, CHW and WWC respectively. These minerals have been reported to be beneficial to human body.

3.3. Sensory qualities of chin-chin produced from composite flour of wheat and chicken meat

The sensory evaluation of the chin-chin produced from the various proportions of the flour was analysed to determine the consumer's preference in the sensory parameters associated with the chin-chin produced. Table 4 shows the scores of the sensory parameters of the chin-chin produced.

The mean scores for the sensory evaluation of chin-chin produced from the blends for wheat flour and chicken meat flour is presented in Table 4. There was no significant difference (p>0.05) in the colour attribute of the samples. The mean scores for colour ranged from 6.80 in sample WWC and 7.60 in sample WWW. 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 chicken meat flour increased. A similar study by *Ilansuriyan et al*., revealed that inclusion of chicken powder in noodles and soup did not affect the colour of the sample [12].

The mean score for the taste for the product ranged from 6.00 to 7.80. The control sample (WWW) was the most accepted in terms of taste while the sample produced from 40% wheat flour and 60% chicken flour (CHW) was the least accepted. The panelists noted that all the samples with chicken flour incorporated in them had the similar taste of chicken meat. There was no significant difference (p>0.05) in the taste of samples CHC, WWC and CHW but there significantly differed (p<0.05) from the control sample.

The texture value ranged from 6.66 - 7.80, 100 %Wheat chin-chin had the highest value of likeness of 7.60 while the samples produced from 40% and 60% level of chicken flour had the lowest value of likeness in terms of texture. The result revealed that the control sample significantly varied (p<0.05) from the rest of the samples which where statistically the same (p>0.05). The findings of Adegunwa *et al*., recorded similar decrease in texture acceptance of chin-chin as the level of substitution of wheat flour with millet flour increased [22].

The flavour of the control sample significantly differed (p<0.05) from those of the samples formulated with chicken flour which were not significantly different (p>0.05) from one another. The mean score for flavour ranged from 5.90 in sample CHW to 8.20 in sample WWW. Flavour is the main criterion that makes the product to be liked or disliked [23].This result did not concur with the findings of Ilansuriyan *et al*., who noted an improved flavour in noodles formulated with chicken powder[12].

There was no significant differences (P>0.05) in crispness of chin chin samples formulated from chicken flour but they significantly differed (p<0.05) from the control sample. 100% wheat chin-chin had the highest value of crispness of 7.90 while sample CHC had the lowest value of 5.90. The crispiness of the chin-chin decreased with inclusion of chicken flour. This is contrary to the report of Eke-Ejiofor and Allen who noted a significant increase in the score of crispiness of chin-chin as the level of tigernut flour incorporation in wheat flour increased. This is probably due the differences in the raw materials used [13].

The overall acceptability scores of the snack bars showed that the control sample (WW1) was the most preferred (7.66) and it significantly differed (p<0.05) from the rest of the samples. However, there was no significant difference (p>0.05) in the overall acceptability of samples CHC (0:100 wheat-chicken flour), CHW (60:40 wheat-chicken flour) and WWC (50:50 wheat-chicken flour) which had mean scores of 6.48, 6.28 and 6.32 respectively. This indicates that the samples fortified with chicken flour were slightly acceptable and they competed favourably with the control sample.

4. CONCLUSION

This study has shown that the addition of chicken flour to wheat based chin-chin improved the nutrient content, particularly the protein, fat, ash, fats, phosphorus, potassium, sodium and magnesium content of the product. The mean sensory scores for the chin-chin showed that the fortified samples were all accepted in all the attributes assessed. However the sample fortified with up to 50% chicken flour was the most accepted and competed favorably with the control sample. This indicates that chicken flour may be of potential in formulation of foods such as chin-chin, biscuit, cakes, etc.

5. RECOMMENDATION

Further studies should be carried out to improve the consumer acceptability and ascertain the shelf life of the product. Chicken flour can find useful application for snacks products for which only wheat flour has been used. And also popularizing the inclusion of chicken flour in products, for which only wheat flour is used, will go a long way to reduce the country's dependency on wheat flour hereby saving scarce foreign exchange.

6. ACKNOWLEDGEMENT

NA

7. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

8. SOURCE/S OF FUNDING

NA

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