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Potentials of indigenous chicken eggs in the preparation of cake and chin chin

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ABSTRACT

In this study, the potential of indigenous egg as functional ingredient in cake and chin chin was investigated. The proximate, colour and sensory characteristics of the pastries evaluated using standard methods. Indigenous eggs showed higher protein content (14.83%) than the exotic (13.61%) eggs. The same trend was observed for their fat contents. Ash and fibre contents of wheat flour and the eggs were generally low. The protein contents of cake (15.53%) and chin chin (10.75%) produced using indigenous chicken eggs were significantly ($p \leq .05$) higher than samples produced using exotic eggs (Cake: 14.12%; Chin chin: 9.47%). In general, as exotic chicken eggs were replaced with indigenous eggs, the crust colour became lighter as measured by their L values. Overall acceptability of the cake samples were very similar for cakes produced from exotic (7.52) and indigenous chicken eggs (7.46) indicating that these two samples of cakes were moderately acceptable. Values obtained for sensory characteristics showed that indigenous eggs may only be suitable for making cakes with comparable quality to those made from exotic eggs. Future studies should make use of food additives to improve the taste of the chin-chin made using indigenous eggs.

1. Introduction

Pastry products are important snack consumed all over the world. Wheat flour, sugar, fat and egg are important ingredients of pastry products (Ashwini et al., 2009). Egg play number of role in foods including cakes and chin-chin. Such roles include among others emulsification, enhancing colour, contributing to the structure and act as a thickener. The type of egg used in cake formulation and preparation may also influence the characteristics of cake such as cake volume, texture as well as oxidative stability of cakes. For instance, Toyosaki and Koketsu (2007) found that the use of silky fowl eggs improved the quality and oxidative stability of baked cakes compared to cake made with White Leghorn eggs. Among the various ingredients used in pastries, eggs are the most costly (Ashwini et al., 2009). Hence, alternatives to eggs are being considered for use in pastry production. Several authors have reportedly produced cakes by partly replacing eggs with freshly processed bovine blood plasma (Johnson et al., 1979), blends of hydrolyzed plasma and beef stock (Lee et al., 1993), soy flour (Glibertson and Porter, 2001) and the combination of emulsifiers and hydrocolloids (Ashwini et al., 2009). Recently, Ashwini et al. (2009) reported the production of eggless cake using hydrocolloids in combination with emulsifiers. According to their report, good quality eggless cake can be produced using hydroxypropylmethylcellulose (HPMC) and sodium stearoyl-2-lactylate (SSL) in the formulation (Ashwini et al., 2009). However, the unique functional properties of egg such as foaming and emulsifying properties that defines cake characteristics makes it extremely difficult to replace egg successfully (Arozarena et al., 2001; Ashwini et al., 2009).

A promising alternative to conventional exotic eggs used mostly in pastries is the indigenous type, which currently is limited to traditional uses as well as breeding. According to Mwacharo et al. (2007), indigenous bird possess unique adaptive traits that allow them to survive and reproduce under harsh climatic, nutritional

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and management conditions. These birds are kept by rural smallholders, landless farmers and industrial labourers, due to their scavenging adaptability, production ability and low maintenance cost (Kitalyi, 1998). Indigenous hen eggs present some potentials for utilization in pastry production since they can be obtained readily. These indigenous hen eggs are mostly hatched into chicks and sometimes are wasted due to improper care given by the owners.

In Africa, including Nigeria, very limited amount of indigenous eggs are consumed by frying and boiling. Other uses include utilization by traditionalist for preparing conclusions and herbal mixtures. Previous studies on indigenous hen egg focused majorly on laying potential of the hen and quality traits of the egg in comparison with exotic hen (Isidahomen et al., 2013; Mekki et al., 2005). Isidahomen et al. (2013) found slight differences, which was not very significant in the albumen and yolk weight of exotic and indigenous hen's egg. However, the authors reported same value for yolk colour for both exotic and indigenous eggs. Although indigenous eggs are fertilized prior to laying, it is possible to handpick the laid eggs before incubation. Hence, there is an opportunity to utilize these indigenous eggs in food applications such as in making cakes and chin-chin. In this study the effect of exotic and indigenous eggs on proximate, colour and sensory properties of cake and chin-chin were investigated.

2. Materials and methods

2.1. Materials

Freshly laid indigenous and exotic chicken eggs were bought from a store in Ilorin, Kwara State, Nigeria. Baking ingredients such as wheat flour, baking powder, butter, sugar, flavour, nutmeg, preservatives and groundnut oil were obtained from a super market in Ilorin, Kwara State, Nigeria.

2.2. Preparation of cakes and chin-chin

The method of Alozie and Chinma (2015) was adopted for the preparation of cake. Briefly, margarine and sugar were creamed manually in a stainless steel bowl until light and fluffy. Eggs were beaten and strawberry flavour was added to the creamed mixture gradually while beating continued. Flour was separately sieved, with nutmeg and baking powder gradually added into the mixture with a metal spoon. Preservative was added and mixed thoroughly until a soft consistency batter was formed. The batter was transferred to a six inch greased baking pan and baked in a preheated oven at 200 °C for 30 min and a further 20 min at a reduced temperature of 170 °C.

The method of Mepba et al. (2007) was adopted for the preparation of chin-chin. Briefly, flour, sugar and baking powder were mixed together in a large bowl. Margarine was cut into small pieces and added to dry ingredients. Nutmeg, preservatives and strawberry flavour were also added and mixed until it is blended in well. In a separate bowl, eggs were mixed together and poured into the flour. The mixture was kneaded until it forms solid dough. Dough was rolled out to $^1/_4$ in. thick, using a small amount of flour so as to keep it from sticking. Then, small sizes of chin-chin were cut out and fried in a deep fryer which was heated to a temperature of 220 °C. Chin-chin were fried in batches until it turned light brown.

2.3. Proximate composition

Moisture, fat and ash contents of eggs and pastries were determined using AOAC (2000) methods. Protein content was determined by the Kjeldahl method (6.25 × N) and total carbohydrate was calculated by difference. Fibre content were determined by standard laboratory procedure.

2.4. Colour

The CIE tristimulus L, a and b parameters of the cake crumbs and crust (3 × 3 × 3 cm) from the midsection of the cakes as well as the crumb of the chin-chin were measured using a using chroma meter (ColourFlex-Diffuse, A60-1014-593, USA). The colorimeter operates on the CIE L, a and b colour schemes, L (lightness) axis – 0 is black, 100 is white, a (red-green) axis – positive values are red; negative values are green and 0 is neutral, b (yellow-blue) axis – positive values are yellow; negative values are blue and 0 is neutral. The instrument was standardized and the samples were placed in the sample holder. Colour measurement was determined in triplicates.

2.5. Sensory evaluation

Briefly, a 9-point hedonic preference scale and a multiple comparison test were used to assess the acceptability of cakes and chin-chin made from indigenous chicken eggs and wheat flour in comparison with cakes and chin-chin made from exotic chicken eggs and wheat flour. Fifty (50) semi-trained panelists, selected from student of the Department of Home Economics and Food Science, University of Ilorin, Nigeria were used for the evaluation. The selected students were those accustomed to eating the samples of cake and chin-chin. Prior to the sensory analysis, they were screened with respect to their interest and ability to differentiate food sensory properties. The samples of cakes were evaluated for crust colour, crumb colour, taste, aroma, texture and overall acceptability while samples of chin-chin were evaluated for colour, appearance, taste, aroma, crunchiness, overall acceptability.

3. Results and discussion

3.1. Physical properties of exotic and indigenous chicken eggs

Exotic eggs showed significantly different ($p \leq .05$) physical properties from the indigenous type (Table 1). The weight for whole egg, egg shell, albumen, yolk and the volumes for albumen and yolk for exotic eggs were higher than those of the indigenous type. Variation in the physical properties of the eggs may be attributed to inherent genetic differences between the exotic and indigenous eggs. Other factors that may influence the physical properties of egg include the diet of the birds, storage conditions as well as the breed of the bird (King'ori, 2012; Zemková et al., 2007). The weight of eggs used in this study were lighter than values (59.74–70.1 g) previously reported in the literature (Ogunwole et al., 2015; Zemková et al., 2007). Furthermore egg shell weight for indigenous egg (4.30 g) was lower but that of exotic egg was higher than values (approx. 6 g) reported for exotic eggs in the

Table 1
Physical properties of exotic and indigenous chicken eggs.

Parameters	Exotic	Indigenous
Egg weight (g)	$50.89^a \pm 0.12$	$36.30^b \pm 0.12$
Shell weight (g)	$6.47^a \pm 0.04$	$4.30^b \pm 0.14$
Albumen and yolk weight (g)	$44.42^a \pm 0.02$	$32.00^b \pm 0.02$
Albumen volume (mL)	$26.00^a \pm 0.10$	$15.00^b \pm 0.02$
Yolk volume (mL)	$17.00^a \pm 0.02$	$15.00^b \pm 0.01$

Mean ± SD. Mean with different superscript along the row are significantly different ($p \leq .05$).
N = Average of ten eggs were used.

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literature (Ogunwole et al., 2015). According to previous report, the egg size may vary within a specie or among species and depends on the age of the bird (King'ori, 2012). For example younger birds reportedly lay smaller eggs than older birds (Alsoyabel et al., 1991). Egg quality is associated with both external and internal qualities. These qualities include those properties of egg that affects its acceptability to the consumers such as cleanliness, freshness, weight, shell quality; yolk index, albumen index, Haugh unit and chemical composition (Song et al., 2000).

3.2. Proximate composition of wheat flour and eggs

The proximate composition of wheat flour and the chicken eggs are presented in Table 2. Carbohydrate (approx. 76%) was the major component of the wheat flour. The fat, ash, fibre and protein contents were very low and compares favorably with the literature (Adebayo-Oyetoro et al., 2017; David et al., 2015; Oyeyinka et al., 2014). Indigenous eggs showed higher protein content (14.83%) than the exotic (13.61%) eggs. The same trend was observed for their fat contents (Table 2). The proximate composition of the eggs in this study is similar to values reported previously (Ogunwole et al., 2015). Variation in the proximate composition of the eggs could be attributed to their diet which could greatly affect the nutritional quality of the eggs. According to previous research, the nutritional profile of egg can be modified through diet to produce eggs with additional health attributes (Fraeye et al., 2012; Surai and Sparks, 2001). Furthermore, chicken eggs that are especially high in omega 3 fatty acids are produced by laying hens that the diet contains polyunsaturated fats (Anton, 2013). Although indigenous hens mostly scavenge and feed around, sometimes, the owners may feed them also with nutritious feed.

Table 2
Proximate composition of wheat flour and eggs.

Parameters	Wheat flour	Indigenous	Exotic
Moisture	$10.04^{c} \pm 0.21$	$74.24^{b} \pm 0.01$	$75.13^{a} \pm 0.01$
Ash	$0.52^{a} \pm 0.02$	$0.82^{b} \pm 0.02$	$0.94^{b} \pm 0.02$
Fat	$0.92^{c} \pm 0.12$	$8.22^{a} \pm 0.10$	$7.33^{b} \pm 0.01$
Protein	$12.43^{c} \pm 0.14$	$14.83^{a} \pm 0.01$	$13.61^{b} \pm 0.01$
Fibre	$0.44^{a} \pm 0.01$	$0.04^{c} \pm 0.01$	$0.08^{b} \pm 0.01$
Carbohydrate	$75.65^{a} \pm 0.12$	$1.87^{c} \pm 0.02$	$2.91^{b} \pm 0.01$

Mean ± SD. Mean with different superscript along the row are significantly different ($p < .05$).

3.3. Effect of egg type on proximate composition of cake and chin-chin

The proximate composition of cakes and chin-chin produced using exotic or indigenous chicken eggs showed significant variation ($p \leq .05$) (Table 3). Protein (9.47–15.53%) and carbohydrate (45.74–67.44%) were the major components of the cake and chin-chin. In general, pastries prepared using indigenous eggs showed significantly ($p \leq .05$) higher protein contents than those prepared with exotic eggs. This could be attributed to the relatively higher protein contents of the indigenous egg (Table 2). The cake samples showed significantly ($p \leq .05$) higher protein contents (approx. 15%) than the chin-chin (approx. 10%) (Table 3). During pastry formulation, higher quantities of eggs were used for cakes (270 g) than for the chin-chin (89 g) samples. This may explain the higher protein content of the cake samples compared with the chin-chin. The protein contents for the chin-chin in this study is slightly higher than values (approx. 8%) reported by Adebayo-Oyetoro et al. (2017), but similar to values (approx. 11%) reported by Akubor (2004). However, higher protein content (approx. 20%) has been observed by other authors for chin-chin (Adegunwa et al., 2014). Variation in protein content of chin-chin could be attributed to the differences in composition of the ingredients used in the respective studies. This seems plausible since milk was added to the chin-chin produced by some authors (Adegunwa et al., 2014; Akubor, 2004).

Egg type as well as the processing conditions seems to affect the moisture content of the pastries (Table 3). Pastries made using indigenous eggs showed significantly ($p \leq .05$) higher moisture content than those made using exotic eggs. Furthermore, cake samples showed substantially higher moisture content (approx. 25%) than the chin-chin samples (approx. 6%). Previous studies

Table 3
Proximate composition of cake and chin-chin (%).

Sample	Moisture	Ash	Fat	Protein	Fibre	Carbohydrate
Cake-E	$23.87^{b} \pm 0.02$	$1.84^{c} \pm 0.02$	$10.61^{a} \pm 0.01$	$14.12^{b} \pm 0.03$	$1.11^{c} \pm 0.01$	$48.45^{c} \pm 0.03$
Cake-I	$25.51^{a} \pm 0.02$	$1.73^{d} \pm 0.00$	$10.52^{a} \pm 0.12$	$15.53^{a} \pm 0.01$	$0.97^{d} \pm 0.00$	$45.74^{d} \pm 0.01$
Chinchin-E	$5.64^{d} \pm 0.02$	$4.21^{a} \pm 0.01$	$9.32^{c} \pm 0.01$	$9.47^{d} \pm 0.01$	$3.94^{a} \pm 0.04$	$67.44^{a} \pm 0.02$
Chinchin-I	$6.56^{c} \pm 0.00$	$3.85^{b} \pm 0.01$	$9.43^{b} \pm 0.12$	$10.75^{c} \pm 0.12$	$3.64^{b} \pm 0.01$	$65.77^{b} \pm 0.00$

Mean ± SD. Mean with different superscript along the row are significantly different ($p < .05$).
Cake-E: Cake produced using exotic chicken eggs.
Cake-I: Cake produced using indigenous chicken eggs.
Chin-chin-E: Chin-chin produced using exotic chicken eggs.
Chin-chin-I: Chin-chin produced using indigenous chicken eggs.

Table 4
Colour parameters of cake and chin-chin.

Sample	Crust			Crumb		
	L	a	b	L	a	b
Cake-E	$43.35^{b} \pm 0.63$	$11.09^{a} \pm 0.03$	$13.00^{b} \pm 0.14$	$52.89^{a} \pm 0.13$	$4.76^{b} \pm 0.06$	$14.59^{b} \pm 0.02$
Cake-I	$47.29^{a} \pm 0.84$	$10.16^{b} \pm 0.04$	$15.96^{a} \pm 0.06$	$54.95^{a} \pm 0.39$	$5.10^{b} \pm 0.02$	$17.83^{a} \pm 0.08$
Chin-chin-E	$38.69^{c} \pm 0.74$	$8.02^{c} \pm 0.51$	$10.19^{c} \pm 0.28$	–	–	–
Chin-chin-I	$48.25^{a} \pm 2.27$	$8.63^{c} \pm 0.01$	$16.99^{a} \pm 1.78$	–	–	–

Mean ± SD. Mean with different superscript along the column are significantly different ($p < .05$).
Cake-E: Cake produced using exotic chicken eggs.
Cake-I: Cake produced using indigenous chicken eggs.
Chin-chin-E: Chin-chin produced using exotic chicken eggs.
Chin-chin-I: Chin-chin produced using indigenous chicken eggs.

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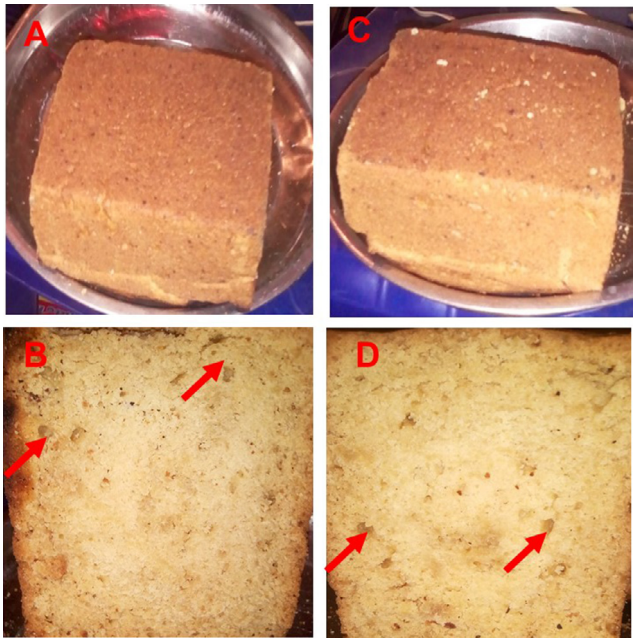

Fig. 1. Whole and cross sections of cakes prepared using exotic and indigenous eggs. Arrow indicates. A: Cakes prepared using exotic egg. B: Cross section of cake prepared using exotic egg. C: Cakes prepared using indigenous egg. B: Cross section of cake prepared using indigenous egg.

reported approximately 5% moisture content for chin-chin (Adebayo-Oyetoro et al., 2017; Adegunwa et al., 2014) and a range of about 22–31% for cakes produced from wheat flour (Lu et al., 2010; Oyeyinka et al., 2013). The difference in moisture content between the two pastries could be associated with the processing methods. Chin-chin samples were fried while the cakes were baked. The low moisture content of the chin-chin samples will enhance the shelf-life compared to the cake sample. The ash (1.73–3.85%) and fibre (0.97–3.94%) contents of cake and chin-chin were very low when compared to other components (Table 3). However, the fat contents were moderate in quantities (9.32–10.61%) and appears very similar to values previously reported in the literature for chin-chin and cakes (Adegunwa et al., 2014).

3.4. Effect of egg type on colour parameters of cake and chin-chin

The crust colours of cake and chin-chin were affected by the replacement of eggs (Table 4). In general, as exotic chicken eggs were replaced with indigenous eggs, the crust colour became lighter as measured by their L values. The crust of the cake and chin-chin produced using indigenous chicken eggs was lighter and more yellowish than cake produced using exotic chicken eggs. The same trend was observed for crumbs of the cake samples, with higher values of L recorded for cake made using indigenous eggs (Table 4). Generally, the "L and b" values of the cake's crust and crumb increased with the replacement of exotic chicken eggs with indigenous chicken eggs, suggesting that the crumb and crust of the cake became lighter and more yellowish. The colour change of baked cakes and fried chin-chin might be related to the physical appearance of both eggs which was different in colour and possibly differences in the sugar composition which may influence the extent and degree of caramelization and maillard browning during baking and frying. This observation in agreement with the appearance and cross sections of the cakes after baking (Fig. 1).

3.5. Effect of egg type on sensory properties of cake and chin-chin

The mean sensory scores for cakes and chin-chin produced using exotic and indigenous chicken eggs are presented in Tables 5and 6 respectively. There were significant ($p \leq .05$) differences in the sensory properties of cakes produced using exotic and indigenous chicken eggs, although the differences were not very substantial. Cake produced using exotic eggs had higher ratings in crust colour and aroma compared to cake produced using indigenous eggs. However, cake produced using indigenous eggs had higher ratings in crumb colour, texture, taste and overall acceptability (Table 5). On a 9-point hedonic scale, the overall acceptability score for the cakes produced from exotic and indigenous chicken eggs were 7.46 and 7.52 respectively, indicating that these two samples of cakes were moderately acceptable.

Values obtained for sensory characteristics of the chin-chin showed that panel members preferred chin-chin made using exotic eggs than its counterparts prepared using indigenous eggs (Table 6). The appearance of the chin-chin were very similar

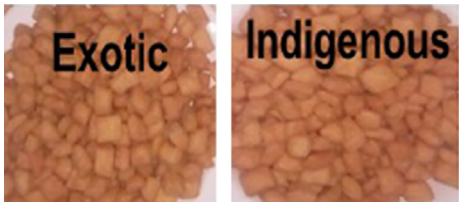

Fig. 2. Appearance of chin-chin.

Table 5
Mean sensory scores of cake.

Sample	Crust colour	Crumb colour	Aroma	Texture	Taste	Overall acceptability
Cake-E	$7.50^{a} \pm 0.83$	$7.20^{b} \pm 1.01$	$7.58^{a} \pm 1.19$	$6.58^{b} \pm 1.43$	$7.40^{b} \pm 1.07$	$7.46^{b} \pm 0.93$
Cake-I	$7.48^{b} \pm 1.09$	$7.38^{a} \pm 1.12$	$7.34^{b} \pm 1.09$	$6.80^{a} \pm 1.46$	$7.62^{a} \pm 1.24$	$7.52^{b} \pm 1.02$

Mean ± SD. Mean with different superscript along the column are significantly different ($p < .05$).
Cake-E: Cake produced using exotic chicken eggs.
Cake-I: Cake produced using indigenous chicken eggs.

Table 6
Mean sensory scores of chin-chin.

Sample	Aroma	Colour	Appearance	Taste	Crunchiness	Overall acceptability
Chin-chin-E	$6.62^{a} \pm 1.56$	$7.80^{a} \pm 1.07$	$7.78^{a} \pm 1.02$	$7.24^{a} \pm 1.22$	$7.84^{a} \pm 1.09$	$7.68^{a} \pm 0.99$
Chin-chin-I	$6.36^{b} \pm 1.44$	$7.34^{b} \pm 1.32$	$7.28^{b} \pm 1.35$	$6.06^{b} \pm 2.02$	$7.42^{b} \pm 1.16$	$7.04^{b} \pm 1.39$

Mean ± SD. Mean with different superscript along the row are significantly different ($p < .05$).
Chin-chin-E: Chin-chin produced using exotic chicken eggs.
Chin-chin-I: Chin-chin produced using indigenous chicken eggs.

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irrespective of the egg type used in the formulation (Fig. 2). Ratings for colour, aroma, appearance, taste crunchiness and overall acceptability for exotic eggs were significantly ($p \leq .05$) higher than those of chin-chin prepared using indigenous eggs. About 80% of the panel members complained about the taste of the chin-chin made using indigenous eggs. From the sensory result, it appears that indigenous eggs may only be suitable for making cakes with comparable quality to those made using exotic eggs. However, food additives may be required to mask to improve the taste of the chin-chin.

4. Conclusion

Indigenous egg had higher protein and fat contents than the exotic egg. However, the physical properties such as weight for whole egg, egg shell, egg albumen, egg yolk and the volumes for albumen and yolk for exotic eggs were higher than the indigenous eggs. Cake and chin-chin prepared using the indigenous egg had slightly higher protein contents than their counterparts produced using exotic eggs. Sensory results showed that indigenous eggs were preferred for cake than the exotic type. However, the indigenous egg seems to affect the taste of the chin-chin as observed by majority of the panel members. Thus, it appears that indigenous eggs may only be suitable for making cakes with comparable quality to those made from exotic eggs. Future studies should make use of food additives to improve the taste of the chin-chin made using indigenous eggs.

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