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Comparative analysis of chicken and guinea fowl egg powder

Olugbemi, T. S[1]., Liman, J[2]., Daramola, E. I[1]., Oyeniran, A. D[1]. and Muhammad, A. A[1]

[1]Department of Animal Science, Ahmadu Bello University, Zaria. 810107 Nigeria
tsolugbemi@abu.edu.ng, +2348086638349
[2]Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Zaria. 810107 Nigeria

Target Audience: *Poultry farmers, confectionary industry, researchers*

Abstract

The objective of this study was to comparatively evaluate egg powders produced from fresh chicken egg (CEP) and Guinea fowl egg (GEP) with a view of determining the suitability of Guinea fowl egg as a possible alternative to that of chicken. The CEP and GEP were made by dehydrating 35 and 34 fresh Chicken and Guinea fowl eggs respectively separately using a dehydrator and smoothly blending the resultant egg crusts. Samples from the CEP and GEP were analyzed for their proximate and mineral composition. An organoleptic assessment using ungarnished and garnished fried CEP and GEP was also conducted. The yield percentage obtained from the Chicken and Guinea fowl eggs were 22.4%, and 28.4% respectively. The proximate composition showed the CEP to be higher in crude protein (46.8%) and moisture (6.20%), than the GEP (42.4% crude protein and 2.10% moisture). The ash and oil percentage of the GEP (5.50% and 35.9%) were higher than that of the CEP (3.75% and 29.9%) respectively. The composition of Ca, Mg, K, Fe, Zn and Mn were highest in CEP while GEP had the highest P and Cu. Fried guinea fowl eggs whether ungarnished or garnished were rated better (P<0.05) in most of the organoleptic indices. It can be concluded that egg powder can be produced from guinea fowl eggs and it gives higher yield than chicken eggs. The guinea fowl egg powder can also be used comparatively to that of the chicken egg in frying, pastries and other confectioneries irrespective of their proximate and mineral variance.

Keywords: chicken; egg powder; guinea fowl; mineral; proximate

Description of Problem

Guinea fowls, being seasonal producers of eggs under the extensive commercial production, produce excess eggs during the production season, which results in glut due to less demand for the eggs as compared to chicken eggs. Whole eggs are basic food material that are always in demand and consumed worldwide. Eggs are effective animal protein with a potential to contribute to food and nutritional security and generate household livelihoods (1). In addition, eggs contain substantial amount of animal protein, vitamins, minerals, high-quality protein, essential fatty acids, phospholipids, sphingomyelin, lutein, zeaxanthin, various bioactive components, antioxidants, and choline (2, 3, 4). It has a considerable place in food industry. Eggs from chicken specie provide a balanced source of nutrients as it is cheap, affordable and also acceptable. It has the characteristics that make it valuable food stuff as they are highly nutritive and are excellent sources of animal protein for the populace. (5) cited egg as the second most proteinous food after mother's milk. Egg products include hard-cooked chopped eggs, precooked scrambled eggs or omelettes, quiches, precooked egg patties, scrambled egg mixes and crapes (6) and egg powder.

Powdered eggs are fully dehydrated eggs. They are made using spray drying in

the same way powdered milk is made. The major advantages of powdered eggs over fresh eggs are the reduced weight per volume of whole egg equivalent and the shelf life (7). Other advantages include smaller usage of storage space and the lack of refrigeration (8). According to (9) food manufacturers go for egg powder due to the low price, storing properties and ease of handling. Powdered, dried eggs are a solution to bulkiness and fragility of fresh eggs as well as storage challenges as they can be stored up to a year or longer under proper storage conditions.

It is estimated that more than 90% of the Nigerian populace live below the poverty level or less than a dollar per day with few people consuming eggs or egg product. There is a cyclical chicken egg glut in some areas which might be on the increase as more individuals embark on poultry production in order to alleviate poverty and unemployment. Apart from the chicken, there is also wide spread household production of guinea fowl (*Numida meleagris*) in Nigeria. Their eggs are an excellent source of animal protein. The objective of this research was to compare the proximate and mineral composition of egg powders from chicken and guinea fowl eggs and to organoleptically assess which is most preferred among the chicken egg and guinea fowl egg powder.

Materials and Method

This study was carried out in the laboratory of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, the Departmental Laboratory of Home and Rural Economics Programme of Samaru College of Agriculture, Zaria and Soil Science Laboratory at the Department of Soil Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria.

Experimental procedure

Egg Powder Production

A dehydrator was used and it involved neatly unshelling 34 pieces of guinea fowl eggs and whisking them up thoroughly with the aid of a blender to enhance homogeneity. Thereafter, the egg slurry was poured unto a fruit-roll sheet (a tiny non-stick layer attached to the dehydrator) and then, the temperature of the dehydrator was set at 145^0 F (62.8^0 C). The whole egg slurry was allowed to dry for about 19hours until completely in brittle form. The dried brittle guinea fowl eggs were packed and poured into a dry blender and blended until a fine powder was obtained. The whole egg powder was bagged in a Ziploc bag and stored for further studies. The same procedure was adopted for the chicken egg powder however 35 pieces of chicken eggs were used.

Proximate Analysis Composition

Proximate analysis was carried out on the guinea fowl and chicken egg powder samples according to (11) procedure. The samples were analyzed for dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), ash and nitrogen free extract (NFE).

Mineral Analysis

Mineral analysis was carried out on both the chicken and guinea fowl egg powder at the Department of Soil science, Faculty of Agriculture, Ahmadu Bello University, Zaria, to determine the following minerals: Calcium (Ca), magnesium (Mg), potassium (K), phosphorus (P), iron (Fe), copper (Cu), zinc (Z), manganese (Mn). Samples (0.2g) of chicken and guinea fowl eggs powders each were digested using H_2So_4, nitric acid and hydrogen peroxide with Atomic Absorption Spectrophotometry used to analyse the minerals.

Preparation of scrambled egg

Egg powder samples from the Chicken and Guinea fowl eggs were reconstituted with water following a method described by (12). Twelve tablespoons of Chicken eggs were mixed with twenty-four (24) tablespoons of water giving a reconstitution ratio of (2:1) of egg and water respectively. Same reconstitution was used for the guinea fowl egg powder.

Reconstituted eggs were made into scrambled spiced (with spices and seasoning) and unspiced (without spice or seasonings) and were subjected to uniform specifications such as quantities of vegetable oil, time of frying. Ten tablespoons of vegetable oil were used for all the slurry and fried for five minutes each using a gas burner.

Sensory Analysis

Using the whole guinea fowl and chicken egg powder samples, scrambled spiced and un-spiced eggs were made to organoleptically evaluate them. The scrambled eggs were served in small quantities to the panelists using a 9-point hedonic scale sheet. The consumer panel composed of about thirty members seated apart to minimize interaction. A sachet of water for mouth-rinsing after tasting each sample was provided. Organoleptic assessment was done using a 9-point hedonic scale score sheet that was given to each panelist to record their perception and observation. At the end of the examination, the forms were retrieved from the panelists and the data were recorded.

Statistical analysis

Data collected were subjected to Independent T test using SPSS (Version 23.0).

Results and discussion

Egg Powder Yield

The total yield of egg powder obtained from 34pieces of guinea fowl eggs and 35 pieces of chicken eggs were 28.4% and 22.4% respectively. Dried eggs are characterized by a reduction in the initial quantity of the liquid egg to a higher concentration of its powder. The chicken egg powder yield compared favourably with the yield percentage result of (21.90%) reported by (13). This result is also indicative that though the guinea fowl egg is smaller than the chicken egg, it yields more products in terms of powder.

Proximate composition of whole guinea fowl and chicken egg powder

The proximate composition of whole guinea fowl egg powder and chicken egg powder as shown in Table 1 indicates that differences existed ($P<0.05$) in the compositions of guinea fowl egg powder and chicken egg powder. The moisture content and crude protein of the chicken egg powder were higher than that of the guinea fowl egg powder by 4.1% and 4.35%. The ash and oil composition of the guinea fowl egg powder were however higher than that of the chicken egg powder by 1.75% and 6.0% respectively. This shows that guinea fowl egg is oilier than chicken egg. Crude fibre from the guinea fowl egg powder and the chicken egg powder were same at 0 which agrees with the report of (14). The differences in the nutritional composition as shown in the proximate analysis could be due to nutritional and genetic differences as reported by (15).

Table 1: Proximate composition (%) of whole guinea fowl egg powder and chicken egg powder

Parameter, %	Guinea fowl egg powder	Chicken egg powder
Moisture	2.10	6.20
Crude protein	42.4	46.8
Crude fibre	0.0	0.0
Ash	5.50	3.75
Oil	35.9	29.9
NFE	14.1	14.35

Mineral Composition of Whole Guinea Fowl and Chicken Egg Powder

The mineral composition values were the highest in the guinea fowl egg powder, where phosphorus (P) was 8853mg/kg and 7959mg/kg for the chicken egg powder. Phosphorus is important for healthy bones and teeth; found in every cell and helps maintain acid-base balance. Copper (Cu) had a higher value for the guinea fowl egg at 121.75mg/kg against that of the chicken egg powder of 84.5mg/kg. All the other minerals except Cd were higher in the chicken egg powder than in the guinea fowl egg powder. They include Ca 995.25 vs 816.75mg/kg, Mg 968.5 vs 757.5mg/kg, K 72 vs 70mg/kg, Fe 35 vs 32mg/kg, Zn 59 vs 40mg/kg and Mn 77.25 vs 75.25mg/kg. Cd was 0.00 for both egg powders. It should be noted that variations can occur in values due to differences in hens diet that layed the eggs and the strains and age of the birds as reported by (16) to have effect on the egg internal quality.

Table 2. Mineral composition of whole guinea fowl egg powder and chicken egg powder

Mineral (mg/kg)	Guinea fowl egg powder	Chicken
Ca	816.75	995.25
Mg	757.50	968.50
K	70.00	72.00
P	8853	7959
Fe	32.00	35.00
Cu	121.75	84.50
Zn	40.00	59.00
Mn	75.25	77.25
Cd	0	0

Proximate Composition of Fresh Guinea Fowl and Guinea Fowl Egg Powder

The proximate composition of whole fresh guinea fowl egg and the powder are shown in Table 3. The guinea fowl egg powder had higher crude protein than the fresh guinea fowl eggs which was 42.4% against 13.56%, Ash 5.50% against 0.79% and Oil 35.9% against 12.09%.

Protein acts as enzymes and hormones in the body. They help maintain fluid, electrolytes and acid-base balance, and strong immunity (17). Protein rich foods such as eggs are of great nutritional importance in developing countries like Nigeria, where there is prevalence of protein malnutrition (18, 19). The ash content in the eggs indicate that egg is rich in calcium,

sodium, magnesium, potassium and iron (20, 21).

The fresh guinea fowl egg had higher Moisture content (72.5%) as against 2.10% in the powder. The higher moisture in the fresh guinea fowl egg is expected since it was not subjected to dehydration and higher temperature like the powdered egg.

Table 3. Proximate composition (%) of fresh guinea fowl egg and guinea fowl egg powder

Parameter (%)	Fresh guinea fowl egg	Guinea fowl egg powder
Moisture	72.5	2.10
Ash	0.79	5.50
Fiber	0.00	0.00
Oil	12.1	35.9
NFE	1.02	14.1

Mineral Composition of Fresh Guinea Fowl Egg and Guinea Fowl Egg Powder

The mineral composition of whole fresh guinea fowl egg and guinea fowl egg powder are displayed in Table 4. The guinea fowl egg powder had higher Ca, Mg, K, Fe and Cu (816.75, 757.75, 70.0, 32 and 121.75mg/kg) than the fresh guinea fowl egg which had 43.50, 23.80, 11.20, 18.0 and 20.0mg/kg respectively. The powdered egg had exactly the same value for Zn with the fresh egg which was 40mg/kg. Zn is a component of many enzymes needed for making protein and genetic material. It functions in sensory perception, wound healing, normal fetal development, normal growth and immune system health (22). Ca had a higher value in guinea fowl egg powder than the chicken egg powder and is an important mineral in blood pressure regulation, immune system health, healthy bones and teeth, muscle relaxation and contraction, blood clotting and nerve functioning.

Table 4. Mineral composition of fresh guinea fowl egg and guinea fowl egg powder

Mineral (mg/kg)	Guinea fowl egg powder	Fresh guinea fowl egg
Ca	817	43.5
Mg	758	23.8
K	70.0	11.2
P	8853	-
Fe	32.0	18.0
Cu	122	20.0
Zn	40.0	40.0
Mn	75.3	-
Cd	0	0

Sensory and Organoleptic Assessment of Chicken and Guinea Fowl Egg Powder

The comparison of organoleptic indices between ungarnished chicken and Guinea fowl egg powder are shown in Table 5 while Table 6 displays that of garnished chicken and Guinea fowl egg powder. Significant differences were observed in most of the indices. The flavor, taste, texture and acceptability of the ungarnished GEP was rated higher ($P<0.05$) than CEP however, there was no significant difference ($P>0.05$)

in the colour of both egg powders (P>0.05). In the case of garnished egg, the colour, texture and taste of the GEP were significantly (P<0.05) rated better than CEP. This indicates a preference for the GEP product.

Table 5: Comparison between ungarnished chicken and guinea fowl egg powder

Parameters	CEU	GEU	SD	P-value
Colour	5.46	5.46	0.31	0.421
Flavour	3.75	4.13	0.25	0.030*
Texture	4.00	5.33	0.44	0.028*
Taste	4.29	5.25	0.31	0.039*
Acceptability	5.25	5.45	3.58	0.047*

*CEU=chicken egg ungarnished; GEU=guinea fowl egg ungarnished; SD=standard deviation; p=probability value; *=significant differences at p<0.05*

Table 6: Comparison between garnished chicken and guinea fowl egg powder

Parameters	CEG	GEG	SD	P-value
Flavour	5.21	5.38	0.94	0.021*
Colour	4.79	4.50	2.06	0.067
Texture	4.96	5.04	0.86	0.033*
Taste	5.33	5.67	0.77	0.048*
Acceptability	6.04	6.42	0.39	0.622

*CEG=chicken egg garnished; GEG=guinea fowl egg garnished, SD=standard deviation; p=probability value; *=significant differences at p<0.05*

Comparison between ungarnished and garnished chicken egg powder and guinea fowl egg powder

A comparison between ungarnished and garnished chicken egg powder as shown in Table 7 as well as ungarnished and garnished guinea fowl egg powder as shown in Table 8. It was revealed that non-significant (P>0.05) differences existed in colour but significant (P<0.05) differences occurred in flavor, texture, taste and acceptability. This shows that garnishing of the fried egg powder increases the sensory evaluation of the various egg powder preparations.

Table 7: Comparison between ungarnished and garnished chicken egg powder

Parameters	CEU	CEG	SD	P-value
Colour	5.46	5.21	0.220	0.404
Flavour	3.75	4.79	0.178	0.035*
Texture	4.00	4.96	0.098	0.010*
Taste	4.29	5.33	0.121	0.011*
Acceptability	5.25	6.04	0.10	0.036*

*CEU=chicken egg ungarnished; CEG=chicken egg ungarnished; SD=standard deviation; p=probability value; *=significant differences at p<0.05*

Table 8: Comparison between ungarnished and garnished guinea fowl egg powder

Parameers	GEU	GEG	SD	P-value
Colour	5.46	5.38	0.221	0.078
Flavour	4.13	4.50	0.642	0.021*
Texture	5.33	5.04	0.144	0.018*
Taste	5.25	5.67	0.350	0.030*
Acceptability	5.45	6.42	0.510	0.045*

*GEU=guinea fowl egg ungarnished; GEG=guinea fowl egg garnished; SD=standard deviation; p=probability value; *=significant differences at p<0.05*

Conclusion and Applications

The outcomes of this research resulted in:

1. Fresh guinea fowl eggs, just like chicken eggs can be processed into powdered eggs to curtail the losses incurred during the production season.
2. Guinea fowl eggs yield more powder than chicken eggs.
3. The study also showed a slight difference in guinea fowl eggs in both the proximate and mineral composition from the chicken egg.
4. Guinea fowl egg powder can be used as a substitute for chicken egg powder in frying and pastries.
5. Guinea fowl egg powder had equal acceptability and palatability as chicken eggs.

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