

Original Research Article

Comparative Nutritional Analysis of Egg Yolks and Egg Albumin of Domestic Chicken, Guinea Fowl and hybride chicken.

ABSTRACT

Aim: The study investigated and compared the proximate, minerals and vitamin composition of egg yolk and egg white of domestic chicken, hybrid chicken and guinea fowl.

Methodology: Three egg samples from domestic fowls, guinea fowl and hybride chicken were purchased from poultry keepers in Minna Nigeria. The yolk and albumin were separated by breaking a small part of the egg shell at one end. They were analyzed for proximate, vitamins and minerals using standard analytical methods. Analysis of variance (ANOVA) at $p < 0.05$ level of significances was also calculated for all the data obtained. The mean were separated using Duncan's Multiple Range Test. All the experiments were carried out in triplicates

Results : The moisture and crude protein content was significantly higher in egg white than in the yolk while the crude fat and ash content was significantly higher in egg yolk than in white for the 3 eggs sample. For the egg yolk the moisture and ash contents was significantly higher in hybrid chicken than in domestic chicken and guinea fowl. The protein and crude fat content in the egg yolk of the 3 eggs had no statistical difference. For egg white the hybrid chicken was significantly lowered in moisture ($75.50 \pm 0.14\%$) but higher in ash (1.32 ± 0.03) content as compared with the guinea fowl and domestic chicken. The protein content was significantly ($p < 0.05$) lowered in domestic chicken (3.48 ± 0.91) as compared with guinea fowl (5.81 ± 0.62) and hybride chicken (5.47 ± 0.88). All elements considered in this study had higher concentrations in the yolk than in the egg-white except for Na whose concentrations were higher in the egg-white than in the yolk. for all the species considered Na concentration ranged from 150mg/kg to 975mg/kg been highest in egg white of hybrid chicken ($975.00 \pm 09.0\text{mg}/100\text{g}$) and lowest in egg yolk of domestic chicken ($172.50 \pm 2.16\text{mg}/100\text{g}$). K^+ concentration ranged from 32.5mg/kg to 321mg/kg been highest in the egg yolk of guinea fowl and lowest in egg white of domestic chicken. Fe^{2+} concentration ranged from 0.90mg/kg to 12.45mg/kg been highest in the egg yolk of guinea fowl and lowest in egg white of hybride chicken. Vitamin C content of egg yolk was higher in hybride chicken (121.50 ± 0.14) and lowest in domestic chicken (97.50 ± 0.71) while the Vitamin A content of egg yolk was higher in hybrid chicken (0.33 ± 0.88) and lowest in domestic chicken (0.21 ± 0.91) For the egg albumin the highest concentration of vitamin C was recorded for hybride chicken (68.50 ± 0.70) and least concentration was recorded for domestic chicken (47.00 ± 2.11) while highest concentration of vitamin A was recorded for guinea fowl (0.78 ± 0.63) and least concentration was recorded for domestic chicken (0.11 ± 0.91).

Conclusion: the guinea fowl, domestic and hybride chicken contain appreciable amounts of lipid minerals and vitamins which could be included in the daily dietary pattern of human. This will help to minimize the risk of nutrients deficiency in the consumers

51
52 **Key words:** proximate, minerals, vitamin egg yolk, egg white,
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54 55 **1.0 INTRODUCTION**

56 Good health start with good nutrition and good nutrition protect the body against
57 disease latter in life. A balanced diet is essential for normal growth, health and
58 preservation of the human body. Beside the main nutritional values which include
59 Carbohydrates, protein, vitamins, etc, the body also required certain important elements
60 needed for various metabolic processes in the body. Eggs have constituted an important
61 part of human diets for centuries because of its high quality protein (Forson *et al.*,
62 2011).

63 There are many types of poultry species' eggs consumable as a protein and amino acid
64 supplement (Trziszka, 2000). The total world production of chicken eggs have been
65 reported amounts to be about 1220 bln annually. Also another poultry species yield 86
66 bln eggs annually (7% of whole egg production) (FaoStat 2011). The question arises
67 whether there are interspecies differences in poultry eggs quality which may affect the
68 nutritive value and quality as human food.

69 In Nigeria, domestic fowl dominated the poultry industry. Out of 150 million poultry
70 population, 120 million (80 %) were indigenous. Domestic fowl constituted 91 % of this
71 while guinea fowl, duck, turkey and others were 4%, 3% and 2% respectively
72 (Adenowo *et al.*, 1999). Chicken eggs are the most commonly-eaten eggs, they are also
73 an inexpensive single-food source of protein. The yolk and albumin values from
74 literature showed 33.04% (chicken yolk), 32.68% (guinea-fowl yolk); 57.10 % (chicken
75 albumin), 50.3% (guinea-fowl albumin) (Adenowo *et al.*, 1999). Another source (Eggs
76 and fetal development, 2009) reported that yolk makes up about 33 % of the liquid
77 weight of the egg.

78 The guinea fowl is a bird native to the African continent (Smith, 2001). It derives its
79 name from the Coast of Guinea where it is believed to have originated (Teye and
80 Gyawu, 2007). The indigenous guinea fowl (*Numida meleagris*) is widely distributed in
81 Africa where it has distinct popularity among small holder farmers. It is believed that
82 guinea fowls were taken to Europe and America by the Portuguese but in these regions
83 the guinea fowls have been scientifically improved resulting in faster growth rate,
84 bigger body size and enhanced egg laying capacity (Teye and Abubakari, 2007).
85 Guinea fowl breeding hens produce thicker shelled eggs in comparison to that of a
86 regular chicken (John, and Kenanao, 2013), however there is paucity of information on
87 the nutritional qualities of eggs from Domestic fowl in comparison with eggs from other
88 poultry species.

89 In this report, attempt was made to evaluate the nutritional levels of the proximate and
90 minerals composition in egg yolks and egg albumin collected from different birds
91 species.

92 **2. MATERIALS AND METHODS**

93 94 **2.1 Source of Materials:**

95 Six (6) samples of domestic fowls' eggs, guinea fowl eggs and Chicken breeders were
96 purchased from poultry keepers in Minna Nigeria.

97 **2.2 Sample Preparation**

The egg Samples were thoroughly washed with distilled water in the laboratory federal university of technology, Minna. Nigeria. The yolk and albumin were separated by breaking a small part of the egg shell at one end and separating the egg albumin from the yolk.

2.2.3 Proximate analysis

Moisture and crude fat content were determined according to the standard methods of A.O.A.C (1990). Ash content was determined at 550°C (Elinge *et al.*, 2012). Crude nitrogen was determined by Kjeldahl method (Elinge *et al.*, 2012) and crude protein determined by using the formula Crude protein = Crude nitrogen $\times$ 6.25 (Alfawaz, 2004). All the analysis was performed in triplicate.

2.2.4 Mineral Analysis

The method of A.O.A.C (1990) was employed for the determination of mineral content.

2.2.5 Vitamin Analysis

Vitamin C and Vitamin A composition of each of the sample, were determined by the method of A.O.A.C (1990).

2.2.6 Statistical analysis

The data obtained were subjected to Analysis of Variance (ANOVA) using SAS statistical package. Means were separated using Duncan's Multiple Range Test (DMRT). Significance was accepted at $P < 0.05$ (Kalidass and Mahapatra, 2014).

3.0 RESULTS

3.1 Proximate

The moisture and crude protein content was significantly higher in egg white than yolk while the crude fat and ash content was significantly higher in yolk than in egg white for the three (3) eggs sample. For the egg yolk the moisture and the ash contents is significantly higher in hybride chicken than in domestic chicken and guinea fowl, The protein and crude fat content in the egg yolk of the 3 eggs show no significant difference . While egg white of the Hybrid chicken is significantly lowered in moisture ($75.50 \pm 0.14\%$) but higher in ash (1.32 ± 0.03) content as compared with the guinea fowl and domestic chicken. The protein content was significantly ($p < 0.05$) lowered in Domestic chicken (3.48 ± 0.91) as compared with guinea fowl (5.81 ± 0.62) and hybride chicken (5.47 ± 0.88)

Table 1: Proximate compositions of egg yolks and egg white collected from domestic chicken (*Gallus domesticus*), Guinea fowl (*Numida meleagris*) and hybrid Chicken.

Sample	Proximates (%)		Crude fat	Ash
	Moisture	Protein		
Egg yolk				

Hybrid chicken	60.45±0.14 ^b	3.43±0.88 ^a	27.65±0.70 ^a	3.42±0.23 ^b
Domestic chicken	55.60±0.16 ^a	3.85±0.91 ^a	30.41± 0.22 ^a	1.50 ± 0.11 ^a
Guinea fowl	50.50.±0.71 ^a	4.30±0.62 ^a	31.49+ 0.41 ^a	2.15 ± 0.25 ^{ab}
Egg white				
Hybrid chicken	75.50±0.14 ^a	5.47±0.88 ^b	2.00 ± 0.03 ^a	1.32±0.03 ^b
Domestic chicken	86.90±0.16 ^b	3.48±0.91 ^a	1.09 ± 0.30 ^a	0.99±0.21 ^a
Guinea fowl	87.45±0.71 ^b	5.81±0.62 ^b	1.21 ± 0.10 ^a	0.70 ± 0.12 ^a

139 Values follow by the same superscript are not differ significantly at p<0.05, values are
140 Mean ± SEM of triplicate determination

141 3.2 Minerals.

143 Table 2 presents the results of mineral analysis of domestic chicken (*Gallus*
144 *domesticus*), Guinea fowl (*Numida meleagris*) and Chicken breeders. All elements
145 considered in this study had higher concentrations in the yolk than in the egg-white
146 except for Na whose concentrations were higher in the egg- white than in the yolk. for
147 all the species considered.

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149
150 **Table 2:** Minerals composition of egg yolks and egg ALBUMIN collected from domestic
151 chicken, Guinea fowl and hybrid Chicken.

Sample	Minerals (mg/100g)			
	Sodium	Potassium	Iron	Calcium
Egg yolk				
Hybrid chicken	850.00±22.4b	162.00±5.88a	3.50±0.70a	2.90±0.23a
Domestic chicken	150.50±7.16a	197.50±3.91a	7.10±0.11b	14.80±0.91b
Guinea fowl	191.00±6.71	321.50±7.62b	12.45.±0.09c	26.60±0.63c
Egg white				
Hybrid chicken	975.00±09.0b	82.00±0.88ab	0.90±0.21a	0.56.50±0.21a
Domestic chicken	172.50±2.16a	32.50±0.91a	2.10±0.01ab	5.80±0.09ab
Guinea fowl	199.00±6.71a	119.50±2.62b	4.45.±0.08b	9.23.±0.22b

152 Values follow by the same superscript are not differ significantly at p<0.05, values are
153 Mean ± SEM of triplicate determination

154 3.3 VITAMINS

156 Table 3 presents the results of vitamins A and C contents of egg yolk and albumin from
157 domestic chicken (*Gallus domesticus*), Guinea fowl (*Numida meleagris*) and Chicken
158 breeders. Vitamin C content of egg yolk is higher in hybride chicken (121.50±0.14)
159 and lowest in domestic chicken (97.50±0.71) while the Vitamin A content of egg yolk
160 is higher in Hybrid chicken (0.33±0.88) and lowest in domestic chicken (0.21±0.91)
161 For the egg albumin the highest concentration of vitamin C is recorded for hybride
162 chicken (68.50±0.70) and least was recorded for domestic chicken (47.00±2.11) while
163 highest concentration of vitamin A is recorded for Guinea fowl (0.78±0.63) and least
164 was recorded for domestic chicken (0.11±0.91)

165
166
167 **Table 3:** Vitamins composition of egg yolks and egg ALBUMIN collected from domestic
168 chicken, Guinea fowl and hybrid Chicken

Sample	egg yolks (mg/100g)		egg albumin (mg/100g)	
	Vit C	Vit A	Vit C	Vit A
Hybrid chicken	121.50±0.14b	0.33±0.88a	68.50±0.70b	0.23±0.23a
Domestic chicken	110.50±0.16ab	0.21±0.91a	47.00±2.11a	0.11±0.91a

	Guinea fowl	97.50±0.71a	0.31±0.62a	52.00±4.09a	0.78±0.63a
169	Values follow by the same superscript are not differ significantly at p<0.05, values are				
170	Mean ± SEM of triplicate determination				

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173 4.0 DISCUSSION

174

175 4.1 Proximate composition

176 Protein is an essential component of human diet which is needed for the replacement of
177 tissue and supply of energy. Protein deficiency cause growth retardation, muscle
178 wasting, oedema, abnormal swelling of the body and collection of fluid in the body of
179 children (Mounts, 2000)

180 The major proximate compositions of hybride chicken, guinea fowl and domestic
181 chicken were found to be, moisture and lipids while the minor compositions were
182 protein and ash. This study revealed that egg white contain more moisture content than
183 the egg yolk, also the egg yolk of hybride chicken contain more water than those found
184 in guinea fowl and domestic chicken. Water has been reported to enhance ease
185 transportation of nutrient and other necessary metabolic reaction. However high water
186 contents of food have been implicated for low shelf life due to microbial attacked
187 (Adeyeye and Ayejugo 1994).

188 Dietary fat functions in the increase of palatability of food by absorbing and retaining
189 flavours. This study also revealed that the eggs yolk and white are good and poor source
190 of Lipids respectively. Although no significantly difference in fat contents of egg white
191 of hybride chicken, domestic chicken and Guinea fowl. The low fat contents of egg
192 white is an important consideration for people who suffer from elevated cholesterol
193 level (Ekumakana, 2005), and can also be recommend as part of weight reducing diets.
194 The lipids contents of egg yolk for the three poultry egg species is high, a diet providing
195 1- 2% of its caloric of energy as fat is said to be sufficient to human beings as excess fat
196 consumption is implicated in certain cardiovascular disorders such as cancer and aging
197 (Antia *et al.*,2006). The fat contents of albumin from domestic chicken and guinea fowl
198 in this study is comparable with that reported for chicken egg and for guinea fowl (Polat
199 *et al.*, 2013).

200 This study revealed low protein contents in three poultry egg species and the little
201 amount presents are more abundant in the egg white, however this findings disagree
202 with the findings of Dudusola, (2010) who reported higher protein contents in egg yolk
203 than egg white from Quai and guinea fowl (Dudusola, 2010). Also in this study no
204 significant difference in the protein content of egg yolk from the three poultry egg
205 species, however the egg white from hybride and guinea fowl chicken contain more
206 protein than egg white of domestic chicken.

207 The ash content give a measure of total amount of inorganic compounds like minerals
208 present in a food. This study revealed that although the ash contents of albumin is
209 higher than that of egg white for all the three (3) poultry species analysed.
210 Similaly,low ash content has been previously reported for egg from Quai and guinea
211 fowl (Dudusola, 2010). This low ash contents is an indication that hybride chicken,
212 domestic chicken and guinea fowl eggs are not good source of minerals for humans.

213 4.2 Mineral

214 Calcium is necessary for the strong bones and teeth. It is relatively high in cereals, nuts
215 and vegetable (James, 1996). The recommended dietary allowance value of calcium is
216 600-1400mg/kg (Bolt, and Bruggenwert, 1978). Calcium helps in the regulation of
217 muscle contraction required by children, infants and foetuses for bones and teeth
218 development (Margaret and Vickery, 1997). The present study show that both egg yolk
219 and white of guinea fowl contain high amount of calcium as compared to the hybrid
220 and domestic chicken. Considering the importance of Calcium, its concentration in egg
221 yolk implies that this can slightly contribute to the amount of dietary calcium.

222 Sodium is the principal exteacellular cation and is used for acid – base balance and
223 some osmo-regulation in the body fluid (Odoemena,. and Ekanem, 2006).. The
224 recommended daily value for sodium is 1100- 3300mg/kg for adults (Margaret and
225 Vickery, 1997). Hybri chicken contain high sodium concentration than the guinea fowl
226 and domestic chicken. However, excess sodium consumption has been implicated in
227 the etiology of hypertension (NRC, 1989).

228 Iron is essential for transport of oxygen in haemoglobin and also involves in energy
229 metabolism. Iron is an important element in the diet of pregnant women, nursing
230 mothers, infants, convalescing patients and the elderly to prevent anaemia and other
231 related diseases (Oluyemi *et al.*, 2006). The recommended daily requirement of iron for
232 man is 6-40 mg/kg (Bolt , and Bruggenwert, 1978). The egg yolk and white was found
233 to contain iron in concentration within the recommended daily requirement. Hybrid
234 chicken was found to have the highest concentration of Iron, this poultry egg species
235 from the result obtained can be used in improving the anaemic condition in iron
236 deficient diabetic patients.

237 Potassium is responsible for nerve action and is very important in the regulation of
238 water, electrolyte and acid – base balance in the blood and tissues (National Research
239 Council [NRC], 1989). It also helps to maintain body weight. In this study, egg yolk
240 from guinea fowl was found to contain the highest concentration of potassium. The
241 level of potassium in this poultry eggs especially the egg yolks is a good indication that
242 its consumption will enhance the maintenance of the osmotic pressure and acid-base
243 equilibrium of the body (Odoemena and Ekanem, 2006).

244 **4.3 vitamins**

245 All the poultry egg species contain considerable amount of vitamin A and C contents
246 which may help essentially in the control physiological oxidative stress (Wright,
247 2005).Vitamin C also has anti-infective, wound-healing, may boost the immune
248 boosting properties (Davey *et al.*, 2000) while vitamin A helps to maintain good sight
249 and prevents certain diseases of the eye (Ross *et al.*, 2010). Vitamins A and C have been
250 reported to have antioxidant properties and may protect body against some forms of
251 cancer (Wright, 2002).

252

253 **5.0 CONCLUSION**

254 It can be concluded that guinea fowl , domestic and hybride chicken contain appreciable
255 amounts of lipid, minerals and vitamins which could be included in the daily dietary
256 pattern of human. This will help to minimize the risk of nutrients deficiency in the
257 consumers.

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