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LIPID PROFILE AND PROXIMATE COMPOSITIONS OF EGGS FROM EXOTIC AND INDIGENOUS BREEDS OF CHICKEN IN NIGERIA

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Abstract

This study was designed to evaluate the proximate compositions and lipid profile of eggs in three strains of laying hens (Heavy local chicken ecotype, SHC; ISA brown commercial laying chicken, IBC; light local chicken ecotype, LLC). Ninety eggs comprising of 30 eggs each from the various chicken strains and representing each treatment group (SHC, IBC, and LLC) were procured and used for the study in a completely randomized design. Each group was replicated thrice with 10 eggs each. Three eggs per replicate were randomly selected and taken to the laboratory for proximate analysis and lipid profile studies. Results of analysis showed that eggs in the IBC group had the highest levels of total cholesterol(TC), triglycerides(TG), and low density lipoproteins(LDL) (139.67, 162.67, and 80.01 , respectively) the least levels of TC, TG, and LDL were observed in the LLC group. High density lipoproteins(HDL) were highest in the SHC and LLC groups. Also, the results of the proximate compositions revealed that percentage ash levels did not vary across the groups. The SHC group had the highest crude protein level with the least values observed in the IBC group. Fat and moisture levels were highest in the LLC and IBC groups, respectively. From the study, we concluded that the eggs from the SHC had the highest levels of HDL and CP, while the LLC group had the least TC, TG and LDL levels. Therefore, we recommend eggs from local chicken types for consumption by individuals with nutritional and health concerns.

Keywords: Egg, Quality, Proximate, Cholesterol, Diabetes,

Introduction

Food insecurity remains a critical issue of concern in Sub-Saharan African, including Nigeria. Poultry, and in particular, chicken egg is regarded as an available and cheap source of animal protein, with no restrictions on its consumption. It is rich in essential amino acids, vitamins, and minerals, and is regarded as a complete food which can be relatively preserved for a lengthier period, when compared to other animal protein sources (Farrell, 2013). Breeds of egg laying chicken in Nigeria include the commercial exotic strains, and different indigenous ecotypes with varying egg production potentials, and distributions across various eco-geographical locations in the country. This local chicken (LC) types which are extensively and semi-intensively kept are known to play vital roles in improving food quality and livelihood of poor and rural families in developing countries whose diet consist majorly of carbohydrate-rich staple foods (Farrell, 2013). Furthermore, the consumption of these LC eggs is locally preferred due to their flavour, taste, low cost, and perceived higher nutritional benefits. Effects of breed, nutrition and environment on the quality characteristics and nutritional composition of chicken eggs have been reported. Therefore, it is possible and relatively easy to manipulate the nutrient levels in this poultry product to suit health and market preferences using appropriate nutritional and management strategies (Wang et al., 2017).

International organizations like the American Heart Association (AHA) and the US dietary guidelines advisory committee (DGAC) recently reported to have relaxed its' restrictions on dietary intake of eggs and cholesterol by healthy individuals (USDA, 2015). Regardless, studies continue to indicate positive association between egg consumption, and increased blood cholesterol, heart-related diseases, and death, particularly in diabetic and hypercholesterolemic individuals, with high sensitivity to dietary cholesterol (Li *et al.*, 2013). Additionally, despite the dismissal of earlier assertions of the role of egg cholesterol in cardiovascular diseases, egg consumptions are still met with negative attitudes, particularly in the developing countries where it should form a key dietary component. Hence, the assessment and documentation of the nutritional and lipid profile of eggs from different economically important chicken breeds is critical for satisfying market preferences, and the nutritional and health concerns of a wide range of consumers.

Marked improvement in the egg quality characteristics of Nigerian heavy ecotype chicken selected over years for egg production have been reported (Agbo, 2015) in the Department of Animal Science, University of Nigeria, Nsukka. Comparative evaluations of egg quality traits in indigenous and exotic breeds of chicken have also been documented (Islam and Dutta, 2010; Fakai *et al.*, 2015). However, the paucity of information on the egg quality and nutrient indices of this selected heavy ecotype chicken population necessitated this study. Also, evaluations of egg quality and nutritional characteristics are crucial to appreciate and improve its nutrient content for the dietary needs of both developing embryos and human consumers. In view of this, this study was designed to evaluate and compare the lipid profile and proximate compositions of eggs from this selected heavy ecotype chicken population (Fulani type) with those of the Nigerian light ecotype (Yoruba type), and the Isa brown strain of exotic chicken.

MATERIALS AND METHODS

Location

The study was conducted at the Nutrition and Biochemistry Laboratory of the Department of Animal Science, University of Nigeria, Nsukka.

Management of Experimental Eggs

A total of 90 clean freshly laid eggs were procured from three breeds of laying hens kept at the poultry unit of the Department of Animal Science Teaching and Research Farm and used for the study. The breeds included were the University of Nigeria heavy local chicken ecotype (SHC) selected for egg production (third generation), Isa brown commercial laying chicken strain (IBC), and light local chicken ecotype (LLC). The eggs were randomly divided into three experimental groups (T1, T2, and T3) on the basis of strain in a completely randomized design (CRD). Each of the groups (T1, T2, and T3) comprised of 30 eggs each from the SHC, IBC, and LLC, respectively, and was replicated thrice with ten (10) eggs each. Eggs of similar sizes and weights ($56.24 \text{ g} \pm 0.02$, $63.69 \text{ g} \pm 0.01$, and $40.36 \text{ g} \pm 0.12$ respectively, for T1, T2, and T3) were selected from the respective strains of laying flock and used for the study. Standard management practices and biosecurity protocols were maintained in the laying units, with the hens fed on same brand of commercial layers mash at least two weeks prior to egg collection. Upon collection, the eggs were carefully handled to avoid breakages and contamination. Afterwards, three eggs each were randomly selected from the respective replicate groups

and taken to the laboratory for the assessment of egg proximate compositions and yolk lipid profile.

Egg Quality Assessment

The egg yolk lipid profile of high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, and total cholesterol (TC) were determined using standard lipid profile kits obtained from Randox laboratory, United Kingdom. The whole egg proximate indices of crude protein, carbohydrate, crude fibre, moisture, ash, and ether extract were determined by the methods described by AOAC (2005).

Statistical analysis

The data collected were subjected to a one way analysis of variance (ANOVA) in statistical package for social sciences (SPSS version 20). Significant different means were separated using Duncan New Multiple Range Test procedure and significance was accepted at 5% probability level.

RESULTS AND DISCUSSION

Yolk Lipid Profile

The results of comparative evaluation of the lipid profile of eggs from three strains of chicken (SHC, IBC, and LLC) are presented in Table 1. As presented in Table 1, there were significant ($P < 0.05$) differences among the treatment groups in all the lipid profile indices considered. The T Chol, TG, and LDL values were seen to be highest ($P < 0.05$) in the IBC group (139.67, 162.67, and 80.01 mg/dl, respectively), and lowest in the LLC group (89.00, 123.00, and 28.00 mg/dl, respectively). The HLC and LLC groups had the highest ($P < 0.05$) HDL values (87.67 and 80.67 mg/dl, respectively). The HDL was observed to be lowest ($P < 0.05$) in the IBC group (37.67 mg/dl).

In agreement with our findings, previous studies (Sarica *et al.*, 2009; Fakai *et al.*, 2015) have reported higher total egg yolk cholesterol in exotic laying hens when compared to eggs from local hens. Contrastingly, Rizzi and Chiericato (2010) documented higher concentration of egg yolk cholesterol in Mediterranean local chicken breed compared to the exotic breeds. The effect of breed or strain, age, diet, and rate of egg production on the yolk cholesterol levels have been reported (Chowdhury *et al.*, 2002). Our findings confirm this and suggest a difference in chicken's rate of cholesterol secretion and transfer to their products with strain. Following many several inconclusive studies, the earlier held perception of the high association of egg and dietary cholesterol with blood cholesterol level and coronary heart disease (CHD) in healthy individuals have been dismissed, and the restrictions on egg consumption by several international organizations relapsed. Of the two main forms of cholesterol (LDL and HDL), elevated levels of its oxidized form (LDL) is regarded as "Bad lipoprotein", and has been associated with arterial hardening and increased risk of health and cardiovascular related issues (Farrell, 2013). Although the effect of egg LDL on blood cholesterol is counteracted by the healthy monosaturated fat contents in eggs, egg consumption remains particularly dangerous, for diabetic and hypercholesterolemic individuals with altered cholesterol metabolism (Njike *et al.*, 2010). The HDL cholesterol is noted for its role in the prevention of heart diseases through the mop up and excretion of free circulating cholesterol (de alvarenga *et al.*, 2010; Farrell, 2013). Although our results showed that the eggs in the LLC group had the least levels of T Chol. and LDL, it also revealed a significantly ($P < 0.05$) lower TC and LDL levels in the SHC compared to the IBC. Furthermore, the higher levels of HDL observed in the SHC and LLC suggest that eggs

from these chickens are healthier and better suited for consumption, especially in individuals with high cholesterol sensitivity.

Table 1: Yolk lipid profile of eggs from three breeds (SHC, IBC, and LLC) of chicken

Parameters	T ₁ HLC	T ₂ IBC	T ₃ LLC	SEM	Sig.
T Chol (mg/dl)	110.33 ^b	139.67 ^a	89.00 ^c	7.49	*
TG (mg/dl)	144.33 ^b	162.67 ^a	123.00 ^c	5.90	*
HDL (mg/dl)	87.67 ^a	37.67 ^b	80.67 ^a	7.98	*
LDL (mg/dl)	47.67 ^b	80.01 ^a	28.00 ^c	7.81	*

T Chol: Total cholesterol; TG: Triglyceride; HDL: High density lipoprotein; LDL: Low Density Lipoprotein; HLC: University of Nigeria selected heavy ecotype local chicken; LLC: light ecotype local chicken; IBC: Isa brown strain; SEM: Standard error of mean; Sig.: Significance; *: Significant at 5 % probability

Proximate Composition

The results of comparative evaluation of the proximate compositions of eggs from three strains of chicken (SHC, IBC, and LLC) are presented in Table 2

Table 2: Proximate composition of eggs from three strains of chicken in University of Nigeria Poultry farm

Parameters	T1 (SHC)	T2 (IBC)	T3 (LLC)	SEM	Sig.
Ash (%)	1.19	1.18	1.19	0.00	NS
CP (%)	13.14 ^a	9.65 ^c	10.67 ^b	0.53	*
Moisture (%)	70.14 ^c	74.78 ^a	72.58 ^b	0.68	*
Fat (%)	11.43 ^b	10.28 ^c	12.70 ^a	0.35	*
Carbohydrates (%)	4.10 ^a	4.11 ^a	2.86 ^b	0.43	*

Crude protein (CP); HLC: University of Nigeria selected heavy ecotype local chicken; LLC: light ecotype local chicken; IBC: Isa brown strain; SEM: Standard error of mean; Sig.: Significance; *: Significant at 5 % probability

The percentage crude protein (CP), moisture, and fat were seen to differ ($P < 0.05$) among the strains of chicken eggs. The percentage ash (1.19, 1.18, and 1.19%) were however not significantly different across the groups. Eggs in SHC group had the highest ($P < 0.05$) CP level (13.14%), while the IBC had the least ($P < 0.05$) value (9.65%). The fat level was highest ($P < 0.05$) in the LLC group. Eggs in the IBC groups was observed to show the least ($P < 0.05$) percentage CP and fat levels. Moisture was highest ($P < 0.05$) in the IBC group and least ($P < 0.05$) in the SHC group.

Our findings are in agreement with those of Fakai *et al.* (2015) who reported similar ranges of egg ash (1.33 and 0.67%), CP (10.13 and 9.42%), fat (10.73 and 11.53%) and moisture (74.50 and 75.50%) levels for the Shika brown and local chicken, respectively. Proteins form key components of living cells, made up of amino acids and nutrients required for growth and maintenance of body tissues. Although the protein levels in these eggs were below the recommended protein requirements of different age and physiological status of humans as reported (Ganong, 2003), they still represented excellent sources of dietary proteins, with the SHC eggs having higher ($P < 0.05$) CP

value. Moisture levels in food products are known to vary with the nature of the food material. According to Hassan *et al.* (2008), moisture levels above 15% promotes microbial proliferation, resulting to food spoilage. The high moisture levels in the eggs observed in our results was because of the freshness of the eggs used in the study. Our results suggest that the eggs from the various strains cannot be kept for a long time in storage. Lower moisture level was seen in eggs from the SHC group, suggesting that these eggs may be capable of being preserved for a longer period. Carbohydrates and fats represent a source of energy reserve for the developing embryo and the dietary provisions for man (Gordon, 2002). Fat is also known to contribute to flavour and tastes in prepared foods. The higher levels of carbohydrates and fats observed in the SHC suggest that the eggs have higher energy reserve and could supply more energy for the dietary needs of man. In addition to nutrition, the strain and age of hens have been reported to cause marked variations in the proximate compositions of eggs at oviposition (Fakai *et al.*, 2015). Because the birds used for this study were subjected to similar diets at least 2 weeks prior to the study, the observed differences in the egg CP, moisture, fat, and carbohydrate levels could be attributed to the effect of strain and possibly age, as the age of the birds were not considered in the study.

Conclusion and recommendation

We concluded that the SHC and LLC had better lipid profile and proximate compositions than the IBC. The selection done on the SHC at UNN yielded great benefits not only in the physical egg characteristics as reported by Agbo (2015), but also in the nutrient content. Further study on human is recommended to determine the effect of its consumption on blood cholesterol and possible risk of CHD.

References

- Agbo, M. C. (2013). Genetic response from forth to sixth generation of index selection in productive traits of the Nigerian heavy local chicken ecotype. A PhD research, Department of Animal Science, University of Nigeria, Nsukka.
- AOAC. (2005). Official methods of analysis, 18th ed. Association of Official Analytical Chemistry, Washington DC.
- De Alvarenga, E.S., de Oliveira, C.P. and Bellato, C.R. (2010). An approach to understanding the deacetylation degree of chitosan. *Carbohydrate Polymers*, 80: 1155-1160.
- Fakai, I. M., Sani, I. and Olalekan, O. S. (2015). Proximate composition and cholesterol content of eggs obtained from various bird species. *Journal of Harmonized Research in Medical and Health Sciences*, 2(2): 18-25.
- Farrell, D (2013). The role of poultry in human nutrition. FAO Poultry Development Review, 1- 8. Available at <http://FAO.org/docrep/013/al712e/al712e00.pdf>. Accessed on 27 January 2021.
- Ganong, M.A. (2003). Integrated food science & technology for tropics. Macmillan Ltd. London pp 180-189.
- Gordon, M.W. (2002). Vitamin and mineral in contemporary nutrition. 5th edition. McGraw Hill New York pp 239-281

- Hassan, L., Dangogo, S.M., Umar, K.J., Saidu, I. and Folorunsho, F.A. (2008). Proximate, mineral and antinutritional factors of Danielliaohvevi seed kernel, Chem class J., 5: 31-36.
- Islam, M.S. and Dulta, R.K. (2010). Egg quality traits of indigenous, exotic and crossbred chickens (*Gallus domestic L.*) in Rajshahi, Bangladesh. *Journal of Life Earth Science*, 5: 63-76.
- Li Y., Zhou, C., Zhou, X. and Li, L. (2013). Egg consumption and risk of cardiovascular diseases and diabetes: A meta-analysis. *Atherosclerosis*, 229(2): 524–530.
- Njike, V., Faridi, Z., Dutta, S., Gonzalez, A.L. and Katz, D.L. (2010). Daily egg consumption in hyperlipidemic adults – Effects on endothelial function and cardiovascular risk. *Nutrition Journal*, 9: 28–36.
- Rizzi, C. and Chiericato, G. M. (2010). Chemical composition of meat and egg yolk of hybrid and Italian breed hens reared using an organic production system. *Poultry Science*, 89: 1239–1251.
- Sarica, M., Sekeroglu, A. and Karacay, N. (2009). Effect of genotype on fatty acid and cholesterol contents of hen's egg. *Asian Journal of Chemistry*, 21: 511–516.
- USDA National Nutrient Database for Standard Reference, US Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory, Beltsville, MD, USA, 2015.
- Wang, J., Yue, H., Wu, S., Zhang, H. and Qi, G. (2017). Nutritional modulation of health, egg quality and environmental pollution of the layers. *Animal Nutrition*, 3: 91-96.