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DIETARY SUPPLEMENTATION WITH *Egeria radiata* (CLAM) SHELL POWDER MODULATES THE LIPID PROFILE OF *Gallus gallus domestica* (BROILERS)

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ABSTRACT

This study evaluated the impact of *Egeria radiata* (clam) shell powder supplemented diet on lipid profile of *Gallus gallus domestica* (broilers). A total of 20 broilers at-day old were used for the study which lasted for a period of 7 weeks. The birds were divided into four different groups of 5 birds each and subjected to the following treatments: Group 1, the control received only standard pelletized chicken feed; Group 2, received standard feed supplemented with 5% *Egeria radiata* shell powder; Group 3, received standard feed supplemented with 10% *Egeria radiata* shell powder and Group 4, were fed with 15% *Egeria radiata* shell powder supplemented diet. The birds were allowed 1 week for acclimatization after which supplemented diet was administered from 1 week of age to 7 weeks of age. At the end of the 7 weeks, the experimental birds were sacrificed, blood samples were collected into plain bottles and allowed to clot. The serum was separated and used for determination of lipid profile. The results showed that the inclusion of *Egeria radiata* shell powder (5 and 10 %) significantly ($P \leq 0.05$) increased high density lipoprotein (HDL-C), relative to control. The positive influence of *Egeria radiata* shell powder on lipid profile of *Gallus gallus domestica* may be due to its high calcium content, which has been shown to correlate with improved blood lipid profile.

Keywords: Dietary Supplementation, *Egeria radiata, Gallus gallus domestica,* Poultry, Sea shells.

INTRODUCTION

The poultry industry plays a crucial role in meeting global protein demand, with broiler chickens being a primary source of poultry meat. Broilers *(Gallus gallus domestica)* are chicken bred and raised specifically for meat production (Singh *et al*., 2022). The behavior repertoires of broiler chickens are similar to those of other gallinaceous birds since they are same species as egg laying hens. Broilers chicks today are those widely grown birds throughout the world as the fastest source of animal's protein (Singh *et al.*, 2022; Egbune *et al*., 2021). Broilers are the best meat producers because of their ability to put on weight in the shortest period (Bukar and Saeed, 2014). The shortest production cycle of broiler chicks is one of the special characteristics of poultry production that provides animal protein for human feeding. Broiler chicks are also easy and convenient to distribute over a wide territory (Lawal and Hanotte, 2021). With the increasing human population, the consumption of meat is increasing in the world as well as intensive animal production and animal welfare. Poultry products are among the important food production in Nigeria that cut across all barrier and age classes all over the world. Due to rapid growth of human population in Nigeria, there is need to build food strength to ensure socio-

economic stability and productivity of human life (Bukar and Saeed, 2014; Tonukari *et al*., 2016). It is important that poultry farming be carried out efficiently for high productivity and sustainability of the industry in Nigeria (Bukar and Saeed, 2014).

Broilers, like other animals, also have a lipid profile that can be of interest in poultry research and production. The lipid profile of broilers, is a vital indicator of their overall health and the nutritional value of their meat (Singh *et al.,* 2022; Egbune, *et al*., 2024). Lipids, including fats and cholesterol, are essential components of avian diets, contributing to energy metabolism and the structural composition of cells. However, the quality and quantity of lipids in chicken meat have direct implications for consumer health. High levels of unhealthy saturated fats and cholesterol in poultry products can lead to adverse health effects, such as cardiovascular diseases (Bukar and Saeed, 2014), in individuals who regularly consume these products. The search for natural and sustainable dietary additives capable of improving the lipid profile of broiler chickens, while maintaining overall health and performance, has led researchers to explore alternative feed supplements (Bukar and Saeed, 2014).

One critical aspect of poultry nutrition is calcium supplementation, which significantly impacts bone health and, subsequently meat quality (Mako *et al*., 2017; Egbune *et al*., 2025). *Egeria radiata* shell powder is a perfect supplement to add calcium to chicken feed (Bai *et al*., 2022). The shells are composed mainly of calcium carbonate which makes up about 95% of the shell's total weight (Akinjogunla *et al.,* 2017). They are also composed of proteins, polysaccharides, and minerals, including calcium, magnesium, sodium, copper, iron, nickel, strontium, and trace elements such as zinc, manganese, selenium, and chromium (Hao *et al*., 2021).

Monitoring the lipid profile of broilers is important for optimizing their production, as excessive fat deposition can lead to reduced meat quality and economic losses. Poultry nutritionists and producers may adjust diets and management practices to achieve the desired balance between lean meat production and overall health (Singh *et al.*, 2022). Research in this area continues to evolve as the poultry industry seeks to improve the efficiency of broiler production while also meeting consumer demand for lean and healthy meat products (Singh *et al*., 2022; Egbune *et al*., 2023). By exploring the impact of *Egeria radiata* shell powder on lipid metabolism, this study aimed to contribute to sustainable poultry farming practices and the production of healthier poultry products.

MATERIALS AND METHODS

Preparation of *Egeria radiata* Shell Powder

Egeria radiata shells were obtained from Itam market, Itam Itu Local Government Area of Akwa Ibom State, Nigeria. The *Egeria radiata* shell powder was prepared from freshly harvested *Egeria radiata* shells. The freshly harvested *Egeria radiata* shells were washed and rinsed thoroughly, ensuring that meat stuck to the shells were effectively removed. The washed *Egeria radiata* shells were air-dried at room temperature in the Biochemistry Laboratory, University of Uyo, Annex Campus, and subsequently oven-dried at 105 °C for 24 h to remove residual moisture and enhance brittleness prior to further processing. The digital heater oven of the Department of Soil Science, University of Uyo was used. Thereafter the oven dried *Egeria radiata* shells were reduced to powder using a mechanical grinder and passed through 0.5mm mesh sieve. The obtained powder was stored in clean dry containers.

Experimental Animals

Twenty (20) chicks at day old were purchased from Agric International Technology and Trade (Agrited) farm limited in Ibadan, Nigeria. The experimental birds were housed in standard cages in the poultry unit of the Department of Animal Science, University of Uyo, Annex Campus. The chicks were allowed to acclimatize for 7days before commencing feeding with

Egeria radiata shell Powder supplemented diet for 6 weeks.

Experimental Design and Diet Formulation

Egeria radiata shell powder was incorporated into a standard pelletized broiler feed to formulate four experimental diets for both starter and finisher phases. The control group received the basal diet without supplementation, while three test diets were prepared by supplementing the basal feed with *Egeria radiata* shell powder at inclusion levels of 5%, 10%, and 15%. All dietary inclusions were calculated on a weight-to-weight basis (% w/w), such that the shell powder constituted 5, 10, or 15 g per 100 g of the total feed mixture. The selected inclusion levels were based on graded supplementation commonly employed in mineral-based feed additive studies to assess dose-dependent nutritional responses and tolerance thresholds.

The experimental diets were formulated on a percentage basis to give a total of 100% per diet for both starter and finisher phases. The ingredient composition of the experimental diets is presented in Table 1.

Table 1: Ingredient composition of experimental diets (%)

Ingredient	Group 1 (0%)	Group 2 (5%)	Group 3 (10%)	Group 4 (15%)
Basal pelletized feed	100.0	95.0	90.0	85.0
***Egeria radiata* shell powder**	0.0	5.0	10.0	15.0
Total	**100.0**	**100.0**	**100.0**	**100.0**

Four experimental diets were formulated for both starter and finisher phases. Group 1 served as the control and received the basal pelletized diet without supplementation. Groups 2, 3, and 4 received the basal diet supplemented with *Egeria radiata* shell powder at 5%, 10%, and 15%, respectively. All diets were prepared on a percentage basis to give a total of 100%.

Animal Sacrifice / Collection and Preparation of Blood Sample for Analysis

At the end of the 7th week, the animals were fasted overnight and sacrificed following the protocol of Abang *et al.* (2018). 5ml of blood sample was collected into plain bottles, allowed to clot and centrifuged at 4000rpm for 15mins. The serum obtained after centrifugation was stored at -20°C until required for estimation of lipid profile.

Determination of Lipid Profile

Total Cholesterol, Triglycerides and High Density Lipoprotein concentration were determined using assay kits from Randox Laboratories Limited. Very Low Density Lipoprotein and Low Density Lipoprotein were calculated using the Friedewald formular and results were expressed in mmol/l. (Friedewald *et al*., 1972); LDL = TC -HDL – VLDL; VLDL = TG/2.2.

Atherogenic index and Coronary risk index were calculated using the mathematical models stated by Kazemi *et al*. (2018)

Atherogenic Index (AI) = LDL-C /HDL-C

Coronary Risk Index (CRI) = (TC/HDL-C)

Statistical Analysis

The results from the study were presented as mean ± standard error of mean (SEM) of 5 replications (n=5). They were analyzed for statistical significance by one-way ANOVA and the mean values that were significantly different from each other were identified by the Duncan Multiple Range Test. $P \leq 0.05$ was considered significant.

RESULTS

Table 2 shows results for lipid profile of *Gallus gallus domestica* fed pelletized standard diet, supplemented with *Egeria radiata* shell powder. 5% and 10% *Egeria radiata* shell powder

supplemented diet significantly increased ($P \leq 0.05$) HDL levels in *Gallus gallus domestica*, relative to control.

Table 2: Serum lipid profile of *Gallus gallus domestica* fed *Egeria radiata* powder supplemented diet.

Parameter	Group 1 (Control)	Group 2 (5% *Egeria radiata*)	Group 3 (10% *Egeria radiata*)	Group 4 (15% *Egeria radiata*)
TC (mmol/l)	2.27± 0.14[a]	2.64±0.18[a]	2.32±0.10 [a]	2.24±0.07 [a]
TG (mmol/l)	0.36±0.11[a]	0.52±0.16 [a]	0.23± 0.06 [a]	0.63± 0.23[a]
LDL (mmol/l)	0.18± 0.03[a]	0.18±0.02 [a]	0.20±0.04[a]	0.28±0.05 [a]
VLDL (mmol/l)	0.16±0.05 [a]	0.24+0.07 [a]	0.11+0.03 [a]	0.29+0.11 [a]
HDL (mmol/l)	1.93±0.14[c]	2.33±0.06[a]	2.16±0.11[b]	2.01±0.05[c]
AI	0.10± 0.02[a]	0.08±0.01 [a]	0.09±0.02 [a]	0.14±0.03[a]
CRI	1.18±0.03 [a]	1.13±0.05 [a]	1.08±0.05 [a]	1.19±0.09 [a]

Values are presented as mean ± SEM (n=5). *Means within the same row bearing different superscript letters ([a], [b], [c]) are significantly ($P \leq 0.05$) different, while means with the same superscript letter are not significantly ($P \geq 0.05$) different.*

TC: Total Cholesterol, **TG:** Triglycerides, **LDL:** Low Density Lipoprotein, **VLDL:** Very Low Density Lipoprotein, **HDL:** High Density Lipoprotein, **AI:** Atherogenic Index, **CRI:** Coronary Risk Index.

DISCUSSION

Cholesterol, which is a constituent of animal cells is synthesized in the liver and is crucial for development of cells. Abnormally high level of cholesterol and abnormal proportion of LDL and HDL are associated with cardiovascular diseases (Kazemi *et al*., 2018). Assessment of lipid profile is important because alterations in serum lipid profile such as increase in TC, TG and LDL-C and reduction in HDL-C are key factors in cardiovascular disease progression (Kazemi *et al*., 2018). AI and CRI are even considered stronger markers for predicting the risk of atherosclerosis and cardiovascular heart diseases (Kazemi *et al*., 2018).

Results from this study indicated that dietary supplementation with *Egeria radiata* shell powder at 5% and 10% significantly ($p \leq 0.05$) increased serum HDL-cholesterol levels in broiler chickens compared with the control group. This finding is consistent with the report of Archibong *et al*. (2015), who observed a significant ($p \leq 0.05$) increase in HDL-cholesterol in Wistar rats administered *Egeria radiata* meat extract. In their study, the elevation in HDL-cholesterol was accompanied by significant reductions in total cholesterol, LDL-cholesterol, and VLDL-cholesterol; effects attributed to bioactive compounds in the meat extract that enhance lipid metabolism and promote reverse cholesterol transport.

However, unlike the study of Archibong *et al*. (2015), which employed a protein-rich meat extract in a rodent model, the present study evaluated the dietary application of *Egeria radiata* shell powder in broiler chickens. The shell is predominantly mineral in composition and lacks the bioactive peptide fractions present in the meat extract, which may explain why improvements in HDL-cholesterol were observed without corresponding reductions in TC, LDL-C, or VLDL-C. Nonetheless, the maintenance of LDL-cholesterol at levels comparable to the control is physiologically

relevant, as elevated LDL-cholesterol is a major contributor to lipid accumulation in atherosclerotic plaques following oxidative modification by reactive oxygen species (Summerhill *et al*., 2019). These findings highlight the novelty of the present study and demonstrate that *Egeria radiata* shell powder can selectively enhance beneficial lipoprotein fractions in poultry without adversely affecting other lipid indices.

The findings of the present study also diverge from those of Idoko *et al*. (2020), who reported significant ($p \leq 0.05$) reductions in total cholesterol, triglycerides, LDL-cholesterol, and VLDL-cholesterol in broilers fed diets supplemented with a mixture of ginger, garlic, and cinnamon, while HDL-cholesterol showed no significant ($p \geq 0.05$) change despite a numerical increase compared with the control. This divergence is expected, as the plant-based additives used by Idoko *et al*. (2020) are rich in phytochemicals such as polyphenols, flavonoids, and organosulfur compounds, which exert hypolipidemic effects through antioxidant activity, inhibition of hepatic cholesterol synthesis, and enhanced lipid clearance.
In contrast, *Egeria radiata* shell powder is predominantly mineral in composition and lacks the phytochemical constituents present in ginger, garlic, and cinnamon. Its influence on lipid metabolism is therefore likely indirect, possibly mediated through mineral–lipid interactions or modulation of lipoprotein transport rather than suppression of cholesterol synthesis. This mechanistic difference may explain why HDL-cholesterol was significantly enhanced in the present study without corresponding reductions in TC, TG, LDL-C, or VLDL-C. Notably, both studies reported no significant differences in atherogenic index (AI) and coronary risk index (CRI), indicating that despite differences in individual lipid fractions, overall cardiovascular risk indices remained unchanged, thereby supporting the physiological relevance and safety of the dietary interventions.

The positive effects of *Egeria radiata* shell powder on lipid profile of broilers may be due to the mineral content of the shell powder notably Calcium. Calcium is known to play a role in lipid metabolism. Some studies suggested that increased calcium intake may lead to a reduction in fat absorption in the intestines, thus potentially lowering LDL cholesterol and causing an apparent increase in HDL-C (Alomaim *et al*., 2019; Shao *et al*., 2022). Govers and Van der Meet (1993) opined that calcium binds to long chain fatty acids in the intestine, leading to insoluble calcium-fatty acid soaps. Due to the reduction in the solubility of fatty acids and monoacylglycerols in the micelle, cholesterol solubility also decreases (Vinarova *et al*., 2016). Therefore, increased calcium intake leads to higher fat excretion in faeces (Christensen *et al*., 2009). Moreover, calcium precipitates bile acids (Govers *et al*.,1994), reducing their enterohepatic recycling and promoting *de novo* synthesis of bile acids from blood cholesterol. Consequently, this may result in an improved blood lipid profile.

CONCLUSION

This study on the effect of *Egeria radiata* shell powder on lipid profile of *Gallus gallus domestica* was observed to cause no significant ($P \geq 0.05$) difference in the levels of TC, TG, LDL-C, VLDL-C, AI and CRI but 5 and 10% supplementation brought about a significant increase ($P \leq 0.05$) in HDL-C level, thus influencing positively the cardiovascular health of *Gallus gallus domestica.* From the results, it is evident that the addition of *Egeria radiata* shell powder in *Gallus gallus domestica* nutrition may have positive effect on the growth performance of broilers.

DECLARATION

Ethical approval

Ethical approval for the research was obtained from the University of Uyo Institutional Health Research Ethics Committee (UU/CHS/IHREC/VOL.1/53).

Conflict of interest: Not applicable

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