Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Growth and Morphometric Response of Black and White Noiler Chickens to Snail Slime Supplementation

Olugbenga Samson Abe

abeolugbenga@gmail.com

Adekunle Ajasin University https://orcid.org/0000-0003-1964-6242

Research Article

Keywords: Plumage colour, body conformation, proximate composition, mineral composition, poultry nutrition

Posted Date: March 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9075577/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Abstract

The study evaluated the effect of snail slime supplementation on growth performance and morphometric traits of noiler chickens with different plumage colours. A total of 192 noiler chickens comprising 96 black and 96 brown plumage types were used for the experiment and were randomly assigned to four treatments. Each treatment has three replicates with 8 birds each. Treatment 1 (T1) served as the control and received vitamins and antibiotics in drinking water, while T2, T3 and T4 received 10 ml, 20 ml and 30 ml of snail slime respectively diluted in 30 cl of water. Weekly body weight gain was measured for four weeks, and morphometric traits including back length, wing length, breast width, breast length, beak length and shank length were also recorded. Data obtained were analysed using the two-way analysis of variance. The results showed no significant differences ($p > 0.05$) among treatments in weekly weight gain across both plumage types. However, black plumage birds generally recorded higher numerical weight gains than brown plumage birds. Survival rate was slightly higher in snail slime treatments (96%) compared with the control group (92%). Similarly, morphometric traits did not differ significantly ($p > 0.05$) among treatments for both plumage types. The study concluded that snail slime supplementation in drinking water did not negatively affect growth performance or body conformation of noiler chickens but could serve as a potential natural additive in poultry production which will subsequently reduce cost on medication and alleviate public health concerns on drug residuals.

INTRODUCTION

Poultry production is a key element animal industry, guaranteeing food security and providing affordable sources of high-quality animal protein in many developing countries. Chicken products are consumed in large quantity due to their relatively low cost, high nutritional value, and short production cycle compared with other livestock species. In poultry production, nutrition and genetics play a major role in the overall performance of the animal. One of the genetic variations in poultry is the plumage colour, though it is only a visible phenotypic characteristic, it may also be associated with genetic differences affecting growth, adaptability, and production traits (FAO, 2012). Studies have shown that variations in plumage colour may be linked to differences in body weight, growth rate, and morphological characteristics among poultry populations (Yakubu et al., 2009). Morphometric characteristics such as back length, wing length, breast width, breast length, beak length, and shank length are important indicators of body conformation and structural development in poultry. These measurements are often used to assess growth patterns, predict body weight, and evaluate the overall physical development of birds (Yakubu and Ari, 2018). Understanding how dietary or environmental factors influence these traits can help improve management and breeding practices in poultry production.

In Nigeria and many parts of Africa, poultry production has expanded significantly in recent years as a result of increasing demand for animal protein and the need to improve household income and nutrition (FAO, 2019). However, its expansion is limited and sometimes hindered by factors such as disease outbreaks, high cost of feed, poor management practices, and dependence on synthetic growth

promoters and antibiotics. The use of medications like antibiotics and other synthetic growth promoters in poultry production has been a common practice for a long time, to improve growth rate, feed efficiency, and control disease. However, the continuous use of these substances has raised serious concerns regarding antibiotic resistance, drug residues in animal products, and potential risks to human health (Windisch et al., 2008; Alagawany et al., 2017). In view of this public health concerns, many countries have restricted or banned the routine use of antibiotic growth promoters in animal production. Thus, there is growing interest in exploring natural alternatives such as plant extracts, probiotics, enzymes, and other bioactive substances that can boost productivity while keeping food safety and animal welfare.

One promising natural substance that has drawn scientific attention in recent years is snail slime (mucus). Snail slime is a biological secretion produced by terrestrial snails. Among the terrestrial snail common in Nigeria is the African giant snail (A. marginata), which is a land, nocturnal, invertebrate animal of the phylum mollusca (Olagbende-dada, 2015). They are mostly found in the forest, farms and gardens where they have unlimited vegetation to feed on. They can be seen commonly through raining season when rain fall is abundant (Robert, 2009). The snail is covered with a shell which protects the soft moist flesh and is known to produce a lot of slime which helps to keep the skin moist. Humans have used snails for food for many generations and nowadays snails are common food consumed by millions of people worldwide (Cagiltay et al., 2011). Snails naturally produce mucus from their salivary glands, epidermal cells of the foot, mantle, and pedal glands (Mariadoss, 2025). Snail mucus is composed of 90–99.7% water, and the remaining 0.3–10% of snail mucus is composed of other active ingredients and diverse bioactive compounds, including glycoproteins, proteoglycans, hyaluronic acid, antioxidants, enzymes, antimicrobial peptides (AMPs), and other compounds (Rashad et al., 2025). High levels of collagen, glycolic acid, allantoin, elastin, vitamins (A, B & E), and several minerals, including copper, nickel, and chromium, are present in snail mucus (Mariadoss, 2025). The bioactive compounds present in snail mucus are responsible for its diverse pharmacological activities, including anti-inflammatory, antioxidant, antimicrobial, anti-acne, anti-aging, wound-healing, and anti-cancer properties (Rashad et al., 2025; Trapella et al., 2018). Reported studies also suggest that the natural adhesive property of snail mucus exhibits superior wound-healing activity through mechanisms involving cell migration, proliferation, and angiogenesis in diabetic wounds. Although snail slime has been extensively studied for its medical and dermatological applications, its potential use as a natural additive in livestock and poultry production is still relatively unexplored.

Despite the increasing interest in natural additives in poultry nutrition, there is limited information on the effects of snail slime supplementation on the growth performance and morphometric characteristics of noiler chickens. Furthermore, the interaction between snail slime supplementation and plumage colour phenotypes has not been widely investigated. Therefore, this study aimed to evaluate the effect of snail slime supplementation in drinking water on the weekly weight gain and morphometric traits of noiler chickens with different plumage colours (black and brown). The findings from this study are expected to contribute to the growing body of knowledge on the use of natural bioactive substances as potential alternatives to conventional growth promoters in poultry production.

MATERIALS AND METHODS

Collection of slime

The slime used for the study was gotten from African giant snail (*A. marginata*). This breed of snail is chosen because it is known for producing high-quality slime. The snails were wash thoroughly with water to remove dirt, mud, and contaminants from their shells and bodies before beginning the extraction process. Water stimulation method was used to collect the slime. The snail was immersed in mild saline solution of 0.9% salt concentration for a period of 2 minutes. After immersion, they were removed and place on a slanted surface to allow for more release of slime to drip down into a collection container. After collection, the slime was filtered to remove any dirt, particles, or snail excrement. This is done using fine mesh filters or sieves. The slime was carefully stored in a bottle and kept under room temperature for the experiment to commence.

Proximate and mineral analysis

The slime was subjected to proximate analysis to determine the ash, crude protein, crude fat, moisture and carbohydrate using the standard AOAC methods (1990). The analysis was carried out as described by Danladi et al. (2020). The estimates were expressed in percentage of the sample weight.

Table 1
Proximate analysis of the snail slime.

Parameters	Percentage
Moisture	96.7
Ash	0.88
Crude fat	0.10
Crude Protein	1.32
Carbohydrate	1.00

The mineral elements comprising calcium, phosphorus, sodium, potassium, magnesium and trace elements (iron and zinc) were determined using the method described by Danladi et al. (2020).

Table 2
Mineral composition of the snail slime.

Parameters	mg/100g
Calcium	6.22
Phosphorus	7.88
Sodium	0.01
Potassium	3.00
magnesium	2.22
Iron	0.44
Zinc	0.55
Copper	0.01
Manganese	0.05
Selenium	0.01

Experimental animals and management

A total of 192 day old noiler chicks, consisting of 96 black plumage and 96 brown plumage were procure from a reputable farm with known plumage colour pedigree. On arrival, the chicks were randomly allotted to four treatments of 48 chicks (24 black plumage and 24 brown plumage) per treatment and 16 chicks (8 black and 8 brown) per replicate at 3 replicates per treatment. Necessary brooding management were carried out for two weeks. The experiment lasted for 28 days. The chicks were fed ad libitum with commercial starter crumble feed for 21 days and commercial grower crumble feed for the last 7 days.

The chicks were given snail slime water solution from day one. The snail slime was added in water at the rate of 10ml in 30cl of water for treatment 2 (T2), 20ml in 30cl of water for treatment 3 (T3) and 30ml in 30cl of water for treatment 4 (T4) while the water in treatment 1 (T1), the control, was added vitamins and antibitotics. This water treatment for all the chicks was carried out for 3 days from day 1 and day 21 of the experiment. The experiment lasted for 28days

Data collection

Data on body weight were measured on weekly basis according to the plumage colour with the aid of sensitive scale of 0.05 sensitivity.

The following parameters were measured;

Initial weight (IW): This was measured at the beginning of the experiment and at the beginning of every week in other to estimate the weekly weight gain.

Final weight (FW): This was measured at the end of every week using a sensitive scale in other to estimate the weekly gain of the animal.

Data on morphometric body traits were measured at two weeks interval with the aid of measuring tape.

The following morphometric data were taken;

- Back length (cm); This was measured as the distance from the base of the beak to the base of the tail.
- Wing length (cm): This was determined by measuring from the beginning of the wing joint to the tip of the wing.
- Beak length (cm): This was measured from the end of the nasal cavity to the tip of the beak.
- Breast width (cm): This was determined by measuring the circumference of the fleshiest (tip of the breast) part of the breast.
- Breast length (cm): This was measured from the cardiac to the basal region.
- Shank length (cm): This was measured from kneel joint to the middle of the feet.

Statistical analysis

The data collected were analysed using a two-way analysis of variance (ANOVA) option of general linear model of SPSS 2015 version 23. Means between treatments were separated for significance using the Duncan multiple range test (DMRT) of the same package at probability level of 0.05. The general linear model is:

$$Y_{ijk} = \mu + T_i + P_j + (TP)_{ij} + \epsilon_{ijk}$$

Where:

- Y_{ijk} = observed response (weight gain or morphometric trait)
- μ = overall mean
- T_i = effect of treatment (i = T1, T2, T3, T4)
- P_j = effect of plumage type (j = Black, Brown)
- $\left(TP\right)_{ij}$ = interaction effect between treatment and plumage
- e_{ijk} = random error term

RESULTS

Proximate Composition of Snail Slime

The proximate composition of snail slime is presented in Table 1. The slime exhibited a very high moisture content (96.7 ± 0.10%), reflecting its primary nature as a biological secretion. The levels of macronutrients were low, with crude protein at 1.32 ± 0.02%, carbohydrate 1.00 ± 0.03%, ash 0.88 ± 0.02%, and crude fat 0.10 ± 0.02%. These results indicate that snail slime is not a significant source of macronutrients but is likely composed of water-soluble biologically active compounds (e.g., glycoproteins and peptides).

Mineral Composition of Snail Slime

Mineral analysis of the snail slime is shown in Table 2. Phosphorus (7.88 ± 0.09 mg/100 g) and calcium (6.22 ± 0.21 mg/100 g) were the predominant minerals, followed by potassium (3.00 ± 0.22 mg/100 g) and magnesium (2.22 ± 0.11 mg/100 g). Trace elements such as zinc (0.55 ± 0.02 mg/100 g), iron (0.44 ± 0.07 mg/100 g), manganese (0.05 ± 0.02 mg/100 g), copper (0.01 ± 0.00 mg/100 g), selenium (0.01 ± 0.02 mg/100 g) and sodium (0.01 ± 0.01 mg/100 g) were present in lower concentrations. The presence of these minerals suggests that snail slime contains essential elements that may support physiological processes when supplemented.

Weekly Weight Gain

The effects of snail slime treatments and plumage types on weekly weight gain of noiler chickens are summarized in Table 3. Across all ages (7, 14, 21, and 28 days), no significant differences were observed in weekly weight gain among the treatment groups (T1–T4) for both black and brown plumage birds ($p > 0.05$). At day 7, black plumage birds in the control group (T1) exhibited the highest mean weight gain; however, differences among treatments were not statistically significant ($p = 0.123$). Similar patterns were observed at subsequent sampling points (days 14, 21 and 28), with p-values all exceeding 0.05 in both plumage groups. Overall, weight gain increased with age in all treatment groups, but supplementation with varying levels of snail slime did not result in significant performance advantages over the control.

Bird survival was high across all treatments, with 96% survival in T2, T3 and T4 (snail slime treatments) compared with 92% in the control, indicating that inclusion of snail slime did not negatively affect survivability.

Table 3
Means and standard error of effect of snail slime and plumage on weekly weight gain of noiler chickens

Day	Plumage	Treatments				p-value
		T1	T2	T3	T4	
7	Black	110.42 ± 16.85	90.30 ± 5.23	97.50 ± 7.78	95.94 ± 13.77	0.123
	Brown	96.93 ± 11.21	88.54 ± 12.68	87.65 ± 4.45	79.34 ± 14.78	0.421
14	Black	285.42 ± 57.86	220.70 ± 14.85	226.33 ± 25.35	225.50 ± 20.51	0.222
	Brown	247.92 ± 13.85	204.66 ± 36.90	210.18 ± 2.02	183.39 ± 1.49	0.524
21	Black	509.87 ± 133.59	413.50 ± 58.70	395.63 ± 54.62	406.75 ± 15.91	0.812
	Brown	407.12 ± 8.85	377.00 ± 35.36	448.09 ± 65.64	318.81 ± 5.23	0.254
28	Black	692.17 ± 168.52	595.85 ± 142.34	545.35 ± 70.92	582.46 ± 25.75	0.089
	Brown	562.23 ± 10.39	535.40 ± 1.56	532.88 ± 30.33	440.90 ± 14.28	0.521
	Survival	92%	96%	96%	96%	

T1 = vitamins + antibitotics; T2 = 10ml snail slime + 30cl of water; T3 = 20ml snail slime + 30cl of water; T4 =30ml snail slime + 30cl of water

Morphometric Traits of Noiler Chickens

The morphometric measurements at the end of the experimental period are presented in Table 4. There were no significant effects of snail slime supplementation on linear body measurements (back length, wing length, breast width, breast length, beak length, and shank length) in either plumage group ($p > 0.05$). While numerical variations existed among treatments, none of these reached statistical significance. For example, back length values varied within a narrow range across treatments in both black and brown plumage birds, and the absence of significant differences suggests that snail slime did not influence skeletal development or conformation under the conditions of this study.

Table 4
Means and standard error of morphometric traits of noiler chickens

Parameters	Plumage	Treatments				p-value
		T1	T2	T3	T4	
Back length	Black	17.83 ± 1.30	18.00 ± 0.87	18.00 ± 1.13	16.78 ± 1.10	0.112
	Brown	18.75 ± 1.44	17.05 ± 0.71	17.00 ± 0.90	15.92 ± 0.68	0.254
Wing length	Black	17.15 ± 1.30	15.33 ± 1.05	16.57 ± 1.36	15.58 ± 1.26	0.562
	Brown	16.75 ± 0.95	15.67 ± 0.73	16.08 ± 0.86	15.50 ± 1.12	0.566
Breast width	Black	22.83 ± 1.75	21.25 ± 1.91	22.50 ± 1.40	21.67 ± 1.19	0.684
	Brown	23.67 ± 1.34	20.92 ± 0.69	22.25 ± 1.17	19.92 ± 1.24	0.998
Breast length	Black	12.08 ± 1.14	12.58 ± 0.61	12.15 ± 1.00	11.75 ± 0.85	0.265
	Brown	12.25 ± 0.77	11.58 ± 0.52	12.00 ± 1.11	11.08 ± 0.94	0.875
Beak length	Black	3.17 ± 0.28	3.23 ± .016	3.45 ± 0.23	3.33 ± 0.22	0.542
	Brown	3.57 ± 0.15	3.13 ± 0.11	3.33 ± 0.27	3.40 ± 0.18	0.678
Shank length	Black	8.48 ± 0.61	7.75 ± 0.86	9.02 ± 0.70	8.31 ± 0.43	0.222
	Brown	9.02 ± 0.52	8.08 ± 0.27	8.58 ± 0.62	7.98 ± 0.37	0.088

T1 = vitamins + antibitotics; T2 = 10ml snail slime + 30cl of water; T3 = 20ml snail slime + 30cl of water; T4 =30ml snail slime + 30cl of water

DISCUSSION

The study evaluated the influence of snail slime supplementation on the growth performance and morphometric traits of noiler chickens with different plumage colours. The results showed that snail slime administration had no statistically significant effect on weekly weight gain across treatments, although observable numerical differences occurred among the treatments and plumage types. These findings suggest that snail slime can be administered to poultry without adverse effects on growth performance. Similar findings have been reported in studies evaluating natural feed additives where alternative bioactive compounds maintained comparable growth performance to conventional antibiotic growth promoters without significant differences in body weight gain (Siddiqui & Alagawany, 2023; Hossain et al., 2024).

The proximate composition of the snail slime revealed a very high moisture content (96.7%) with relatively low levels of crude protein (1.32%), carbohydrates (1.00%), crude fat (0.10%), and ash (0.88%). The high moisture content indicates that snail slime is primarily a fluid secretion rather than a dense nutrient source. Previous studies have also reported that snail mucus contains a large proportion of

water (Danladi et al., 2020) along with glycoproteins, enzymes, peptides, and antimicrobial compounds responsible for its biological activity (Cilia and Fratini, 2018). Consequently, the limited macronutrient content observed in the present study may explain why snail slime supplementation did not significantly improve body weight gain of the birds. Despite the relatively low nutrient concentration, the presence of crude protein and carbohydrate fractions in the slime suggests the presence of biologically active peptides and glycoproteins. These compounds have been reported to possess antimicrobial, antioxidant, and immunomodulatory properties that may enhance gut health and physiological stability in animals (Agada et al., 2023; Tufail et al., 2025). Improved gut health has been shown to promote nutrient absorption efficiency and reduce pathogenic microbial load in poultry production systems. Natural additives containing such bioactive compounds are increasingly investigated as alternatives to antibiotic growth promoters because they can improve health status and disease resistance without contributing to antimicrobial resistance (Siddiqui and Alagawany, 2023).

Table 2 showed the mineral composition of the snail slime which further highlights its potential functional value. Although these minerals were present in relatively small amounts, they play essential roles in various metabolic and physiological processes in poultry. Calcium and phosphorus are critical for bone mineralization and skeletal development in poultry, while potassium and magnesium are important for maintaining electrolyte balance, enzyme activation, and neuromuscular function (Commercial Poultry Nutrition, 2023). Research on snail tissues has also shown that snails naturally contain important minerals such as calcium, phosphorus, magnesium, and zinc that contribute to biological functions and immune regulation in animals and humans. (Mariadoss, 2025). Trace minerals such as iron and zinc identified in the snail slime also contribute significantly to physiological processes including oxygen transport, immune system function, and enzyme activity. Studies have shown that zinc and iron are particularly important for maintaining immune competence and metabolic regulation in poultry (Hossain et al., 2024). However, the concentrations of these minerals in the slime were relatively low compared with typical dietary mineral requirements for poultry, which may explain why morphometric traits such as back length, wing length, breast width, and shank length were not significantly affected by the treatments.

From Table 3, birds in the control group (T1) that received vitamins and antibiotics generally recorded higher numerical weight gain compared with those receiving snail slime treatments (T2–T4) across most weeks, particularly among the black plumage birds, although, the differences were not statistically significant ($p > 0.05$). This suggests that although conventional antibiotic-vitamin supplementation may slightly enhance early growth performance, snail slime supplementation did not negatively affect growth of the birds. This observation agrees with previous reports that alternative natural products used as feed additives may support growth without producing significant differences compared with conventional growth promoters (Windisch et al., 2008; Toghyani et al., 2015). Across the weeks, black plumage birds tended to show slightly higher weight gains than brown plumage birds. This trend could be attributed to genetic or physiological differences associated with plumage phenotype. Plumage colour has been reported to sometimes correlate with genetic variations influencing growth and productivity traits in poultry (FAO, 2012; Yakubu and Ari, 2018). However, the non-significant p-values recorded in this study

indicate that plumage colour did not exert a strong influence on weight gain when birds were subjected to similar management conditions.

Interestingly, survival rates were high across all treatments, with snail slime treatments (T2, T3, and T4) recording 96% survival compared with 92% in the control group. This may suggest a possible health-supporting property of snail slime. Snail slime is known to contain bioactive compounds such as glycoproteins, antimicrobial peptides and antioxidants that may contribute to improved immunity and disease resistance in animals (Trapella et al., 2018; Bortolotti et al., 2016). The relatively high survival rate observed in the snail slime groups could therefore indicate a protective or supportive physiological effect.

The morphometric traits presented in Table 4 also showed no significant differences ($p > 0.05$) among treatments for both plumage groups. Parameters such as back length, wing length, breast width, breast length, beak length and shank length remained relatively similar across all treatments. These findings indicate that snail slime supplementation did not adversely affect skeletal growth or body conformation of the birds. The absence of significant differences in morphometric measurements suggests that the nutritional or bioactive components of snail slime neither enhanced nor impaired structural development of the birds. Morphometric traits are largely influenced by genetics, nutrition and environmental conditions (Yakubu et al., 2009). Since all birds in this experiment were managed under the same environmental and feeding conditions, the similarities observed across treatments were expected. This revealed that administering snail slime in the water did not lead to any statistically noticeable changes in weight gain across the different plumage variants. While plumage colour has been documented to affect growth and development in poultry (Olaniyi et al., 2023), the dosage and duration of administration of snail slime in this study may not have been sufficient to elicit significant effects on weight gain. Furthermore, it could be that snail slime exerted more pronounced effects on health parameters like immunity or digestion, rather than directly on growth at this instance.

CONCLUSION

The study concludes that supplementation of snail slime in drinking water did not significantly influence weekly weight gain or morphometric development of noiler chickens, irrespective of plumage phenotype, under the experimental conditions. Although body weight gains were numerically higher in the control group (vitamins + antibiotics), differences across treatments were not statistically significant ($p > 0.05$). This suggests that snail slime supplementation did not negatively affect growth performance compared to conventional growth promoters.

Notably, birds receiving snail slime supplementation showed marginally higher survival rates (96%) than the control group (92%), indicating potential health-promoting effects. The proximate analysis revealed that snail slime is predominantly a high-moisture biological secretion with low macronutrient content, while mineral profiling confirmed the presence of essential trace elements such as calcium, phosphorus, potassium, and zinc. Although the nutrient concentrations were not sufficient to drive significant growth

enhancement directly, the presence of bioactive proteins, glycoproteins, and micronutrients may contribute to intestinal health and immune function, which could support survivability and overall well-being.

Declarations

Competing interest:

No conflicting interest in the process of the study.

Data availability

The data is available on request.

Funding:

No funding was received from any individual, funding organization or corporate body for the study.

References

1. Agada DE, Sar TT, Ujoh JA, Ameh LO, (2023) Antibacterial susceptibility of selected pathogenic bacteria to snail slime. African Health Sciences, 23(4), 177–182. ttps://doi.org/10.4314/ahs.v23i4.20
2. Alagawany M, Farag MR, Dhama K, Patra A, (2017) Nutritional significance and health benefits of natural feed additives in poultry. International Journal of Pharmacology, 13(8), 112–121.
3. AOAC (1990) Offical Methods of Analysis. Association of official Chemists. 15th Ed. Association of official and Analytical Chemists; 234.
4. Bortolotti D, Trapella C, Bernardi T, Rizzo R, (2016) Letter to the Editor: Antimicrobial properties of mucus from the brown garden snail *Helix aspersa*. Br J Biomed Sci., 73(1):49–50. doi: 10.1080/09674845.2016.1155377. PMID: 27182678.
5. Cagiltay F, Erkan N, Tosun D, Selçu A, (2011) Amino Acid, Fatty Acid, Vitamin and Mineral Contents of the Edible Garden Snail (*Helix aspersa*). Journal of Fisheries Sciences.com, 5(4): 354–363.
6. Cilia G, Fratini F, (2018) Antimicrobial properties of terrestrial snail and slug mucus. Journal of Complement Integrated Medicine, 15(3) doi: 1 0.1515/jcim-2017-0168. PMID: 29596054.
7. Danladi JG, Umezuruike GO, Amaech CC, Haruna GS, Abdullahi MH, Okoh VI, (2020) Proximate and mineral composition of snail slime (*Achatina marginata*). World Journal of Pharmacy and Pharmaceutical Sciences, 9(11), 2304–2512

8. FAO (Food and Agriculture Organization). (2012). Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 11. Rome, Italy.
9. FAO (Food and Agriculture Organization). (2019). Poultry sector Nigeria: FAO animal production and health livestock country reviews. Rome, Italy.
10. Hossain ME, Kim GM, Lee SK, Yang CJ, (2024) Effects of herbal extract supplementation on growth performance, nutrient digestibility, and immune response of broiler chickens. Frontiers in Animal Science, 5, 1703112. ttps://doi.org/10.3389/fanim.2024.1703112
11. Mariados AVA, Wen-Ling W, Chia-Jung Y, Jui-Yang L, Chun-Hsu Y, (2025) Snail as a multifunctional biological resource: Nutritional value and pharmacological applications. Food Research International, 223(2);
12. Olagbende-Dada SO, (2015) Effects of Bluish Liquid (hemonlymph) from the Giant African snail (*Archachatina marginata*) on the blood coagulation time and erythopoietic volume. African Journal of pharmacy and pharmacology, 9(9): 295–298.
13. Olaniyi WA, Adejayan FA, Adejoju A, Adedayo PO, Adebomi AE, Abidakun SO, Aderekun SO, Adedeji BO, Abiri DS, (2023) Comparative growth performance among Noiler chickens of black and brown plumage patterns at starter phase. Annals of Anim. Bio. Res., 3(1): 73–77
14. Rashad M, Sampò S, Cataldi A, Zara S, (2025) From Nature to Nurture: The Science and Applications of Snail Slime in Health and Beauty, J Cosmet Dermatol, 24(2):e70002. doi:
1
0.1111/jocd.70002. PMID: 39973020; PMCID: PMC11840295.
15. Robert N, (2009) Amazing facts about snails. Snails and slugs (Gastropoda), Vienna, Austria, 1999–2009. http://weichtiere.at/english/index.html.
16. Siddiqui S, Alagawany M, (2023) Natural growth promoters and antibiotic alternatives in poultry nutrition: A review. Animals, 13(9), 1421. ttps://doi.org/10.3390/ani13091421
17. Toghyani M, Toghyani M, Gheisari A, Ghalamkari G, Mohammadrezaei M, (2015) Growth performance and immune response of broiler chickens fed dietary herbal extracts. Poultry Science Journal, 3, 45–51.
18. Trapella C, Rizzo R, Gallo S, Alogna A, Bortolotti D, Casciano F, Zauli G, Secchiero P, (2018) HelixComplex snail mucus exhibits pro-survival, proliferative and pro-migration effects on mammalian fibroblasts. Scientific Reports, 8, 17665. ttps://doi.org/10.1038/s41598-018-35816-3
19. Tufail T, Bader U, Ain H, Ashraf J, Mahmood S, Noreen S, Ijaz A, Ikram A, Arshad MT, Abdullahi MA, (2025) Bioactive Compounds in Seafood: Implications for Health and Nutrition. Food Sci Nutr. 13(4):e70181. doi:
1
0.1002/fsn3.70181. PMID: 40260061; PMCID: PMC12009756.
20. Windisch W, Schedle K, Plitzner C, Kroismayr A, (2008) Use of phytogenic products as feed additives for swine and poultry. Journal of Animal Science, 86(E-Suppl.), E140–E148.

21. Yakubu A, Ari MM, (2018) Relationships between body weight and linear body measurements in indigenous chickens using path analysis. Journal of Applied Animal Research, 46(1), 378–384. ttps://doi.org/10.1080/09712119.2017.1284074
22. Yakubu A, Salako AE, Imumorin IG, (2009) Comparative study of body weight and linear body measurements in Nigerian indigenous chickens. Tropical Animal Health and Production, 41, 1011–1017.