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GROWTH PERFORMANCE AND OXIDATIVE STATUS OF BROILER CHICKS FED DIETS SUPPLEMENTED WITH LYSOLECITHIN

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ABSTRACT

Study was conducted to evaluate the effect of supplemental lysolecithin at different levels on the growth performance of broiler chicks. One hundred and eighty (180) day-old broiler chicks were used for the study. The birds were randomly allotted to five treatment groups of 36 birds each, and assigned to five treatments using a completely randomized design (CRD). The treatments were as follows: Treatment 1,0g lysolecithin; Treatment 2, 100g lysolecithin/100kg of feed; Treatment 3, 200g lysolecithin/100kg of feed; Treatment 4, 300g lysolecithin/100kg of feed and Treatment 5, 400g lysolecithin/100kg of feed. Each treatment was replicated 3 times with 12 birds per replicate. Feed and water were provided to the birds ad libitum. Results showed that there were significant differences ($p < 0.05$) among the dietary treatments in final body weight, total weight gain and average daily weight gain, average daily feed intake, Feed Conversion Ratio FCR, Protein Efficiency Ratio PER and feed cost per kg gain values of the broiler chicks. Birds fed diets containing lysolecithin had significantly ($p < 0.05$) higher final body weight, total weight gain and daily weight gain values than those fed the control diet (diet containing 0% lysolecithin). Birds in treatment 2 (diet containing 100g of lysolecithin /100kg of diet) had the highest average daily feed intake value. Birds fed diets containing lysolecithin had similar FCR values and these were significantly ($p < 0.05$) lower than the FCR value of birds fed the control diet. Birds fed diets containing lysolecithin had similar PER values and these were significantly ($p < 0.05$) higher than the PER value of birds fed the control diet. Birds fed diets containing lysolecithin had similar feed cost per kg gain values and these were significantly ($p < 0.05$) lower than the feed cost per kg gain value of birds fed the control diet. It was concluded that the inclusion of lysolecithin as a feed additive in the diet of starter broiler birds improved feed efficiency, growth performance and reduced feed cost per kg weight gain of birds.

Keywords: Broiler Chicks, Performance, Oxidative Status, Lysolecithin, Diets.

1. INTRODUCTION

The Nigerian population is increasing at an alarming rate, with a projected population growth of 400,000 million people by 2030. The continued expansion in urbanization, from 34.8% in 2000 to 49.5% by 2017, has implications for food availability and affordability (Owoo, 2021). Thus, there is a great need for animal scientists to avert malnutrition, especially in children, through livestock intensification. The livestock sector is anticipated to transform as part of the Economic Recovery and Growth Plan implementation, with the Agricultural Promotion Policy 2016-2020 prioritizing investments in the dairy and poultry sectors to commercialize production and reduce the demand-supply gaps (FAO, 2017). However, one of the predominant factors that have discouraged most farmers from engaging in the sector is the high cost of poultry feed (Anaeto *et al*., 2009; Anosike *et al*., 2018). Using unconventional (low cost) feed ingredients available locally to formulate the least-cost feed formulation was found to reduce the cost of poultry feeds. Thirumalaisamy *et al.* (2019) recommended using potential feed ingredients in poultry feed formulation. However, such feed ingredients require more supplementation of nutrients viz, amino acids, toxin binders, micronutrients, etc. One of the supplements that can improve nutrient utilization of the potential feed ingredients is lysolecithin. Lysolecithins have proven to be a cost-effective solution to improve fat emulsification and consequently fat digestion and nutrient absorption in broilers (Poultry World, 2017). For optimal fat digestion, fat needs to be emulsified by the phospholipids contained in the bile acids. However, young broilers have a low bile acid concentration, which is deficient in the jejunum walls. Adding lysolecithin to feed has reportedly improved the performance of broiler chickens by eliciting gene expression in the intestinal epithelium, leading to enhanced collagen deposition and villus length (David *et al*., 2017). Furthermore, Brautigan *et al*. (2017) reported that lysolecithin supplementation (1,000 g/T) to diets containing a combination of animal and vegetable fats increased villi height and mRNA abundance of collagen genes and collagen staining in the jejunal villi. Some studies reported improved weight gain and feed conversion ratio (FCR) (Zhang *et al*., 2011). Lysolecithin acts to improve the health and performance of the intestine, leading to better fat and oil absorption and increased performance of broiler chickens. There was, however, no statistical link between the type of dietary fat or oil and the growth response to lysolecithin addition in a large meta-analysis study conducted by Wealleans *et al*. (2020). Until recently, the beneficial effects of lysolecithin in broilers were thought to be due to lysophosphatidylcholine (https://pubmed.ncbi.nlm.nih.gov/?). The present study was therefore designed to investigate the growth performance of broiler chicks fed varying dietary levels of lysolecithin.

2. MATERIALS AND METHODS

2.1 Location and duration of the Study

The study was carried out at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. The study lasted 28 days.

2.2 Experimental materials and diet

Maize, soybean meal, palm kernel cake and other feed ingredients were used for the study. Broiler starter diet was formulated and the test material added as a supplement. The composition of the basal diets (no lysolecithin) is shown in Table 1.

Table 1: Percentage composition starter broiler diet

Ingredients	Percentage (%)
Maize	41.7
Soybean meal	31. 00
Palm kernel cake	14.80
Local fish meal	5.00
Bone meal	4.00
Limestone	2.5
*Vitamin/mineral premix	0.25
Methionine	0.25
Lysine	0.25
Iodized salt	0.25
Total	100
Calculated compositions:	
Crude protein (%)	22.04
Energy (Mcal/KgME)	2.50
Crude fibre (%)	5.00

*Vit A – 10,000.00 iu., D_3-2,000 iu., B_1-0.75g., B_2-5g., Nicotinic acid – 25g., Calcium pantothenate 12.5g., $B_1$2-0.015g., K_3-2.5g., E-25g., Biotin – 0.050g., Folic acid –1g., Manganese 64g., Choline chloride 250g., Cobalt-0.8g., Copper 8g., Manganese 64g., Iron –32G., Zn-40g., Iodine-0.8g., Flavomycin-100g., Spiramycin 5g., Dl-methionie-50g, Selenium 0.6g., Lysine 120g., BA

2.3 Experimental animals and management

One hundred and eighty (180) day-old broiler chicks were used for the study. The birds were randomly allotted to five treatment groups of 36 birds each, and assigned to five treatments using a completely randomized design (CRD). The treatments were designated as follows: Treatment 1,0g lysolecithin; Treatment 2, 100g lysolecithin/100kg of feed; Treatment 3, 200g lysolecithin/100kg of feed; Treatment 4, 300g lysolecithin/100kg of feed and Treatment 5, 400g lysolecithin/100kg of feed. Each treatment was replicated 3 times with 12 birds per replicate. Each treatment group was replicated three times with 12 birds per replicate. The birds in each replicate were brooded in a deep litter pen measuring 1.50m x 1.50m in the experimental poultry house. The poultry house was an open-sided one; the sides and demarcations between individual pens were covered with wire gauze. The litter material was fresh wood shavings. Heat was provided with charcoal pots placed under metal hovers. Feed and water were provided to the birds *ad libitum* while additional light was provided at night using kerosene powered lamps to enable the birds eat at night. The chicks were vaccinated against Newcastle and Gumboro diseases as at when due.

2.4 Data Collection and measurements

Body weight and feed intake were measured. Feed intake was done daily by a weigh back technique, in which feed remaining at the end of the day was subtracted from the initial feed offered to the birds. The difference between the feed offered and the leftover is considered as feed consumed. Body weight of the birds were measured and recorded on a weekly basis. Data obtained were used to calculate feed conversion ratio (FCR), average daily weight gain and protein efficiency ratio. Feed conversion ratio was calculated from these data as gramme feed consumed per gramme weight gained over the same period.

2.5 Slaughter and collection of samples for oxidative status

On the 28th day of the experimental period, three birds were randomly selected from each treatment and feed-fasted for 8 hours. The birds were slaughtered by severing the jugular vein, scalded in warm water for a minute and de-feathered by manual plucking. Following the slaughter, breast meat samples were obtained for oxidant status and stored at 4^{o}C until the analysis was done. Breast meat (10g) was taken from each slaughtered bird and used to determine the activities of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx). The activity of the (SOD) was assayed in the tissue homogenates at 560 nm based on the methods described by Kakkar *et al.* (1984). One unit of enzyme activity was defined as that amount of enzyme which caused 50% inhibition of nitrobluetetrazolium reduction/mg protein. Catalase activity was determined at room temperature based on the method of Aebi (1974), and the absorbance of the sample was measured at 240 nm in an UV spectrophotometer. The concentration of (GPx) homogenates was measured, as described by Jollow *et al*. (1974). All of the enzyme activities were expressed as per mg of protein and the tissue protein was estimated according to the method of Lowry *et al.* (1951) using bovine serum albumin (BSA) as a standard. The malondialdehyde (MDA) level was analyzed with 2-TBA, monitoring the change of absorbance at 532 nm with a spectrophotometer (Jensen *et al*., 1997).

2.6 Proximate and Statistical Analyses

Feed and fecal samples were assayed for proximate composition by the method of AOAC (2006). Birds were also randomly assigned to each of the five treatments in a completely randomized design. Data collected were analyzed using one-way analyses of variance (ANOVA) for completely randomized design (CRD) using a Stat Graphic Computer Package (SPSS, 2007) Model. Significantly different means were separated using Duncan's New Multiple Range Test (Ducan, 1955) option in SPSS.

3.RESULTS AND DISCUSSION

3.1 Effect of Supplemental Lysolecithin at Different Levels on the Growth Performance of Broiler chicks

Table 2 shows the proximate composition of the experimental diets while data on the effect of supplemental lysolecithin at different levels on the growth performance of broiler chicks are shown in Table 3. Significant ($p < 0.05$) differences existed among treatments in all the parameters evaluated.

Table 2: Proximate Composition of the Experimental Diets

Lysolecithin levels(g/100kg of Diet)	**0**	**100**	**200**	**300**	**400**
Components/Diets	**1**	**2**	**3**	**4**	**5**
Dry matter (%)	89.93	91.00	89.70	91.00	90.50
Crude protein (%)	22.81	22.8	22.82	22.8	22.83
Ether extract (%)	2.5	2.00	2.50	1.80	4.00
Crude fibre (%)	4.50	5.50	5.00	5.50	6.00
Nitrogen-free extract (%)	57.12	58.10	57.38	58.40	54.67
Gross energy (Kcal/g)	3000.05	2993.50	3009.50	2987.80	3036.50

Table 3: Effect of supplemental lysolecithin at different levels on the growth performance of starter broiler birds

Lysolecithin levels(g/100kg of Diet)	**0**	**100**	**200**	**300**	**400**	
Parameters/Treatments	**1**	**2**	**3**	**4**	**5**	**SEM**
Initial body weight (g)	48.68	48.43	48.93	49.15	48.18	0.15
Final body weight (g)	656.25^{a}	745.83^{b}	758.33^{b}	720.77^{ab}	735.43^{b}	12.65
Total weight gain(g)	607.57^{a}	697.33^{b}	709.41^{b}	671.62^{ab}	687.26^{b}	12.69
Av. daily weight gain (g)	21.70^{a}	24.90^{b}	25.34^{b}	23.98^{ab}	24.54^{b}	0.45
Total Feed intake(g)	1349.9^{bc}	1383.2^{c}	1349.9^{bc}	1266.7^{a}	1316.6^{ab}	10.52
Av. daily feed intake (g)	48.21^{b}	49.40^{b}	48.21^{b}	45.24^{a}	47.02^{a}	0.38
Feed conversion ratio	2.23^{b}	1.99^{a}	1.90^{a}	1.89^{a}	1.92^{a}	0.04

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Protein intake(g)	10.99^{bc}	11.26^{c}	10.99^{bc}	10.32^{a}	10.72^{ab}	0.08
Protein efficiency ratio	1.97^{a}	2.21^{b}	2.31^{b}	2.31^{b}	2.29^{b}	0.04

[a,b,c,]Means on the same row with different superscripts are significantly (P<0.05) different.
SEM = Standard error of the mean

3.1.1 Live Weight and Weight Gain

The final body weight, total weight gain and daily weight gain of the broiler chicks fed varying dietary levels of lysolecithin from day one to day 28 of the experiment are shown in Table 3. There were significant differences ($p < 0.05$) among the dietary treatments in final body weight, total weight gain and average daily weight gain values of the starter broilers. Birds fed diets containing 100g lysolecithin/100kg of feed; 200g lysolecithin/100kg of feed and 400g lysolecithin/100kg of feed (Treatments 2,3 and 5, respectively) had significantly ($p < 0.05$) higher final body weight, total weight gain and daily weight gain values than birds fed the control diet (diet containing 0% lysolecithin). Birds fed diets containing lysolecithin had similar values for final body weight, total weight gain and daily weight gain. Birds fed diets containing 0% lysolecithin and those fed diet containing 400g lysolecithin/100kg of feed (treatment 4) had similar values for final body weight, total weight gain and daily weight gain.

3.1.2 Feed Intake

Table 3 shows the data for total feed intake and average daily feed intake of starter broilers fed varying dietary levels of lysolecithin from day one to day 28 of the experiment. There were significant differences ($p < 0.05$) among the dietary treatments in both the total feed intake and average daily feed intake values of the starter broilers. Birds in treatment 1 (control diet), 2(diet containing 100g of lysolecithin /100kg of diet) and 3(diet containing 200g of lysolecithin /100kg of diet) had the highest average daily feed intake values and these were similar. Birds in treatment group 4 (diet containing 300g of lysolecithin /100kg of diet) had the least total feed intake value and this was similar to the total feed intake value of birds in treatment5(diet containing 400g of lysolecithin /100kg of diet). Birds in treatment 2 (diet containing 100g of lysolecithin /100kg of diet) had the highest total feed intake value and this was similar to the total feed intake values for birds in treatments 1(control) and 3 (diet containing 200g of lysolecithin /100kg of diet).

3.1.3 Feed Conversion Ratio

Dietary treatments had significant ($p < 0.05$) effect on feed conversion ratios (FCR) of the birds. Birds fed diets containing lysolecithin had similar FCR values and these were significantly ($p < 0.05$) lower than the FCR value of birds fed the control diet (diet containing 0% lysolecithin).

3.1.4 Protein intake and Protein Efficiency Ratio

There were significant differences ($p < 0.05$) among the dietary treatments in protein intake values and protein efficiency ratios (PER) of the birds. Birds in treatment group 4 (diet containing 300g of lysolecithin /100kg of diet) had the least protein intake value and this was similar to the protein intake value of birds in treatment5 (diet containing 400g of lysolecithin

/100kg of diet). Birds in treatment 2 (diet containing 100g of lysolecithin /100kg of diet) had the highest protein intake value and this was similar to the protein intake values for birds in treatments 1(control) and 3 (diet containing 200g of lysolecithin /100kg of diet). Birds fed diets containing lysolecithin (treatments 2 to 5) had similar PER values and these were significantly ($p < 0.05$) higher than the PER value for birds fed the control diet (diet containing 0% lysolecithin).

3.1.5 Cost implication of feeding varying dietary levels of lysolecithin to starter broiler birds

Table 4 shows the cost implication of feeding varying dietary levels of lysolecithin to starter broiler birds. There were significant differences ($p < 0.05$) among the dietary treatments in feed cost per kg, cost of daily feed intake, cost of total feed intake and feed cost per kg gain. The cost of one kg of the control diet was the least but it was similar to the cost of one kg of diet 2(diet containing 100g of lysolecithin /100kg of diet). The cost of one kg of diet 5 (diet containing 400g of lysolecithin /100kg of diet) was the highest but it was similar to the cost of one kg of diet 4(diet containing 300g of lysolecithin /100kg of diet). Birds in treatment1 (control) had the least costs of average daily feed intake and total feed intake values and these were similar to the costs of average daily feed intake and total feed intake values for birds in treatment 2. Birds in treatment5 had the highest costs of average daily feed intake and total feed intake values.

Table 4: Cost implication of feeding varying dietary levels of lysolecithin to starter broiler birds

Lysolecithin levels(g/100kg of Diet)	**0**	**100**	**200**	**300**	**400**	
Parameters/Treatments	**1**	**2**	**3**	**4**	**5**	**SEM**
Feed cost per kg(₦)	350.35^{a}	570.35^{ab}	790.35^{bc}	1010.35^{cd}	1230.35^{d}	83.15
Cost of average daily feed intake(₦)	16.89^{a}	27.49^{ab}	38.1^{bc}	45.71^{c}	57.85^{d}	3.79
Cost of total feed intake(₦)	472.97^{a}	787.08^{ab}	1066.97^{bc}	1282.7^{c}	1624.06^{d}	105.96
Feed cost/kg Gain(₦)	781.28^{a}	1135.00^{a}	1501.67^{b}	1909.56^{b}	2362.27^{c}	148.98

^{a,b,c,d}Means on the same row with different superscripts are significantly ($P<0.05$) different.
SEM = Standard error of the mean

Birds in treatments1 (control) and 2 had similar feed cost per kg gain values and these were significantly lower than the feed cost per kg gain values for birds in other treatments. Birds in treatment 5 had the highest feed cost per kg value. Birds in treatments 3 and 4 had similar feed cost per kg gain values.

3.1.6 Effect of Supplemental lysolecithin at Different Levels on the oxidative status of starter broiler birds

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Data on the effect of supplemental lysolecithin at different levels on the lipid oxidative status of starter broiler breast meat and on the anti-oxidative enzyme activity in breast meat of the broiler birds are presented in Table 5. Supplementation of the starter broiler diets with lysolecithin had no significant ($p > 0.05$) effect on the parameters evaluated.

Table 5: Effect of Supplemental lysolecithin at Different Levels on the oxidative status of starter broiler birds

Lysolecithin levels(g/100kg of Diet)	**0**	**100**	**200**	**300**	**400**	
Parameters/Treatments	**1**	**2**	**3**	**4**	**5**	**SEM**
SOD(IU/L)	9.46	9.48	9.3	10.14	9.50	0.14
Catalase(mg/dl)	0.61	0.61	0.59	0.55	0.59	0.01
MDA(mg/dl)	3.01	2.76	3.34	2.93	2.65	0.13
GPx(mg/dl)	6.60	6.27	6.49	6.54	6.55	0.11
GSH(mg/dl)	0.37	0.3	0.36	0.29	0.37	0.02
GR(IU/L)	11.31	12.25	11.17	11.34	11.57	0.16

Means on the same row without superscripts are statistically similar (P>0.05).
SEM = Standard error of the mean

3.2 DISCUSION

3.2.1 Effect of Supplemental Lysolecithin at Different Levels on the Growth Performance of Starter Broiler Birds

Results revealed improved BWG and efficiency of feed utilization when supplemental lysolecithin was included in starter broiler bird's diet, BWG was highest with 200 g/100kg of dietary supplemental lysolecithin while feed utilization efficiency also improved in all lysolecithin supplemental diets and was best with diet containing 300g of lysolecithin /100kg of diet. This performance can be attributed to the supplementation effect due to increased fat digestion and nutrient absorption. Lysolecithin plays a crucial role in promoting efficient fat digestion, absorption and utilization in animals, their emulsifying properties facilitate the breakdown of dietary fats into smaller droplets increasing the surface area available for enzymatic degradation by lipase (Jan, 2023). The result of this present study is in line with the reports of Jan (2023) who found that lysolecithin are effective dietary emulsifiers that promote fat utilization and enhance growth performance especially in young animals. Similarly, Zhang *et al.*(2011) and Zhao and Kim(2017) attributed enhancement in growth performance of broiler birds to lysolecithin's ability to stimulate appetite and improve feed utilization efficiency, possibly through increased fatty acid digestibility. Feed intake and protein utilization of starter broiler birds were significantly impacted by supplemental lysolecithin; feed intake decreased with increasing levels of supplemental lysolecithin and was least in the diet containing 300g of lysolecithin /100kg of diet, which was similar to the birds fed diets containing 400g of lysolecithin /100kg of diet). Protein utilization was also significantly improved in birds fed diet containing 300g of lysolecithin /100kg of diet. The observed performance can be attributed to the dietary supplementation with lysolecithin which may have decreased bile acid deconjugation, potentially enhancing fat utilization in broilers fed low-density diets (Zhang, *et al*., 2011). The result obtained in the present study is inline with reports of Zhang *et al.*(2011) , Zhang *et al.*(2022) and Zhao and Kim(2017) who found that broilers can regulate their energy intake by modifying their feed intake as dietary energy concentration changes, and this can be used to explain the reduced feed intake in treatment 4. Similarly, efficient fat digestion in supplemental lysolecithin diets may have influenced the utilization of other nutrients such as protein. Cost-benefit analysis of feeding varying dietary levels of lysolecithin to starter broiler birds revealed significant impact on all parameters evaluated. Feed cost per kg, cost of average daily feed intake, cost of total feed intake and feed cost per kg gain all increased with increasing levels of supplemental lysolecithin. Birds fed diet containing 0% lysolecithin had the least cost values however, birds fed diet containing 100g of lysolecithin /100kg of diet had comparable and similar cost-benefit values with birds fed the control diet. This observation can be attributed to incremental cost of the supplemental material lysolecithin, however the comparable result of the birds fed treatment 2 (diet containing 100g of lysolecithin /100kg of diet) to the birds fed treatment 1 (control diet) and the effects of supplemental lysolecithin on bird's performances in this present study lays credence to the benefits of using lysolecithin in starter broiler bird's diets. Result of this present study is in line with reports of Jan, (2023) who revealed that the principle behind the use of Lysolecithin which include improved fat digestion and absorption as well as enhanced nutrient utilization opens opportunities to replace expensive fat sources with more economical alternatives thereby reducing feed cost while maintaining optimal growth and productivity. The effect of Supplemental lysolecithin at different Levels on the oxidative status of starter broiler birds revealed non-significant difference on parameters evaluated. This observed non- significant response of birds on supplemental lysolecithin is an indication of the positive response responsible for maintaining the key role in the cellular control of reactive oxygen species associated with oxidative stress (Min and Ahn, 2005). Results of the present study suggest that the test diets were devoid of toxins that trigger oxidative stress; which has severe implications on poultry's health status and production efficiency by disturbing the chicken's gastro-intestinal tract (GIT) which is a delicate organ responsible for proper nutrient absorption and digestion (Gonzalez-Rivas *et al*., 2020). Result of this present study suggest that the inclusion of supplemental lysolecithin in starter broiler birds' diets enhanced free radical scavenging activities and decreased lipid peroxidation in broiler fed dietary lysolecithin (Zangeneh *et al.* 2020).

4. CONCLUSION

It is evident from the results obtained in the present study that the inclusion of lysolecithin as a feed additive in the diet of starter broiler birds improved feed efficiency, growth performance and reduced feed cost per kg weight gain of birds, especially at 100g of lysolecithin per 100kg of feed.

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