GROWTH PERFORMANCE AND BLOOD LIPID PROFILE OF PULLET CHICKENS FED DIFFERENT FEED FORMS SUPPLEMENTED WITH OR WITHOUT OYSTER MUSHROOM (*Pleurotus ostreatus*)

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ABSTRACT
In a bid to determine the growth performance and blood lipid profile of pullet chickens fed different feed forms supplemented with or without oyster mushroom (OM),three hundred and twenty (320) day old Harco Black pullet chicks were brooded for five weeks before birds were allocated based on weight equalization on the basis of feed forms (mash and pellet) and OM supplementation (without and with 1g of OMper kg of feed) into four (4) treatments for an experiment which lasted for 11 weeks. Each treatment consisting of 80 birds was replicated eight (8) times with ten (10) birds per replicate. Data collected were arranged in a 2 × 2 factorial layout and subjected to Analysis of Variance in a Completely Randomized Design. Final weight, average weight gain and average feed intake in the grower phase were significantly ($p<0.05$) higher (1244.69, 11.13 and 106.11 g) in birds given pelletized feed and lower (1146.25, 9.27 and 105.08 g) in birds fed mash. Low density lipoprotein measured in the grower phasewas significantly ($P<0.05$) higher (27.32 mg/dl) in birds fed diets without oyster mushroom than 18.82 mg/dl recorded in birds fed diets supplemented with oyster mushroom. Therefore, improved weight gain, feed conversion ratio, and reduction in low density lipoprotein can be achieved by feeding pullet chickens with pelletized feed supplemented with oyster mushroom.

Keywords:pullets, Mash, pelletized, oyster rmushroom, performance, blood lipid profile.

INTRODUCTION

The advantage of poultry over other livestock is primarily due to the short and relatively quick turn over on investments and high quality protein products (Adeyemo*et al.*, 2010). Feed is the greatest cost item in poultry production representing 60 – 70% of the total production cost, with the cost of ingredients accounting for the major portion of feed cost (Nolan *et al*., 2010). New developments in the production and processing of feed for use in the poultry sector are promoted in order to increase the quality and safety of feed and to achieve a more energy-efficient feed production. Pelleting is the most common thermal processing method in the production of poultry feed. A major step in the pelleting process is the conditioning of mash prior to pelleting (Skoch*et al*., 1981), which is generally accomplished by adding steam to the mash feed. Offering feed to poultry in pellet form enhances the economics of production by increasing feed intake, and thus growth performance and feed efficiency. Feed processing further add to the cost of feed (Nolan *et al*., 2010), however, it provides an opportunity to improve performance. These improvements have been attributed to higher density, improved starch digestibility resulting from chemical changes during pelleting, increased nutrient intake, changes in physical form, and decreased energy spent for eating (Calet, 1965; Jensen, 2000).

On the other hand, the use of ethno-veterinary herbs such as mushrooms are known to have considerable health-promoting benefits based on their content of antioxidants, phenolic compounds, tocopherols, carotenoids, and antibacterial compounds (Zhou *et al*., 2010). The use of mushrooms can operate as alternatives to antibiotic growth promoters (AGP) in poultry due to the ban and use of AGPs in livestock rearing by the European Union (Guo*et al*., 2004). Mushrooms with their flavour, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries and has been utilized a long time ago for both food and medicine (Eswaran and Ramabadran 2000; Cheung 2010). Oyster mushroom, (*Pleurotus ostreatus)*, is a common edible mushroom and studies with *Pleurotus ostreatus* have demonstrated various antimicrobial, antiviral and anticancer properties (Bobek and Galbavy 2001; Jedinak and Sliva, 2008). Oyster mushrooms (*Pleurotus ostreatus*) have been reported to contain many valuable benefits such as rich in dietary fibre, protein, vitamins and mineral while having low fat and calorific values (Sogunle*et al.*, 2019).Besides its nutritive values, the unique functionality of β-glucan is its contribution towards healthy characteristics (Manzi and Pizzoferrato 2000). However, the utilization of feed forms supplemented with oyster mushroom in pullet chickens' production in order to bridge the ever-widening animal protein source in human's diets in the developing countries has not been widely researched.

Based on this background, this study aimed to determine the growth performance and blood lipid profile of pullet chickens fed different feed forms supplemented with or without Oyster mushroom.

MATERIALS AND METHODS

Ethical Statement

This study was performed in accordance with the recommendations of the Animal Ethics Committee guidelines of the Federal University of Agriculture, Abeokuta.

Experimental site

The experiment was carried out at the Poultry Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria which is located on Latitude 7^{o} 10' N and Longitude 3^{o} 2' E (Federal University of Agriculture, Abeokuta Agro-meteorology Unit). The prevailing climatic condition is tropical and it lies in the rain forest region of the country. The area has an annual rain fall of 1037mm and temperature range of 28^{o}C to 36^{o}C in the wet and dry seasons, respectively.

Processing of test ingredient (Oyster mushroom)

Fresh oyster mushrooms (*Pleurotus ostreatus*) were obtained from a popular market centre within Abeokuta Metropolis. The intact mushrooms were oven dried at 60 °C and properly blended. The blended mushrooms were incorporation into the diet by thorough hand mixing.

Preparation of pelletized feed

The dried mash feed was passed through a 1mm sieve screen, weighed and thoroughly mixed by hand for approximately 10 minutes. Water was added to the mixture to attain a consistency appropriate for passing through a hand operated extruder. The paste was homogenized by kneading for an additional 10 minutes. A hand extruder was used to produce pellets of about 2mm diameter. The extruder strands was oven dried at 30 °C for 24 hours and was stored at room temperature.

Experimental birds and management

A total of three hundred and twenty (320) day old Harco Black pullet chicks were purchased from a reputable hatchery in Ogun state. Brooding was done for five weeks before birds were allocated based on weight equalization on the basis of feed forms (mash and pellet) and Oyster mushroom supplementation (-OM and +OM) into four (4) treatments. Each treatment consisting of 80 birds was replicated eight (8) times with ten (10) birds per replicate. The birds were reared intensively on deep litter system. The experiment lasted for 11 weeks (i.e. chick phase: 5 – 8 weeks; grower phase 8 – 16 weeks). The experimental birds were fed *ad libitum* on the formulated diets shown in Table 1, and water was supplied *ad libitum*.

Descriptions of experimental treatments are;

(i) Birds fed mash form of feed supplemented with1g of oyster mushroom per kg of feed.
(ii) Birds fedmash form of feed without oyster mushroom.
(iii) Birds fed pellet form of feed supplemented with1g oyster mushroomper kg of feed.
(iv) Birds fedpellet feed without oyster mushroom.

Data collection

Data were collected at chick (5 -8 weeks) and grower (8 – 16 weeks) phases

1. Growth performance parameters

The following growth performance parameters were measured and recorded on weekly basis:

- **Average feed intake (g/bird)** = $\frac{\text{Total feed offered(g)– Left over (g)}}{\text{Number of birds per replicate}}$
- **Average body weight gain (g/bird)** = $\frac{\text{Final weight (g) – initial weight (g)}}{\text{Number of birds per replicate}}$
- **Feed Conversion Ratio (FCR)**: FCR = $\frac{\text{total feed consumed (g)}}{\text{Body weight gain (g)}}$

2. Blood collection and analyses

At 8^{th} and 16^{th} week of age, two birds per replicate were selected and 4 ml blood samples were collected in the morning between 7:00 am and 9:00 am by vein puncture. About 2 ml of blood sample collected used for haematological analysis was stored in Bijou bottles with ethylene-diamine tetra acetate (EDTA) as anticoagulant while the other 2 ml was stored in plain bottles without coagulant for blood lipid profile analysis. Sample bottles containing the collected blood were placed in ice packs to maintain a cool and stable temperature and immediately sent for laboratory analysis.

Blood lipid profile

For the analysis of blood lipid profile, blood samples were maintained in collection tubes with no additives for 2 h at 20 to 22 °C and then centrifuged (Minifuge RF, Heraeus, Hannover, Germany) at 1200 × g and 4 °C for 20 min. Serum was separated and stored frozen at –30 °C until assayed. Serum cholesterol, triglyceride, High Density Lipoprotein, Low Density Lipoprotein and Very Low Density Lipoprotein were analyzed using commercially available test kits by Randox laboratories, United Kingdom (Model BT294QY).

Statistical analysis

Data collected in this experiment were arranged in a 2 × 2 factorial layout (i.e. two feed forms (mash and pelletized) and two modes of oyster mushroom supplementation (-OM and +OM) and subjected to Analysis of Variance in a Completely Randomized Designas contained in minitab® version 17.1.0 (Minitab, 2013). Significant ($p<0.05$) differences among means were separated using Tukey's test of the same software.

Experimental model is as follows;
$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \Sigma_{ijk}$
Where:
Y_{ijk} = Individual Observation
μ = Population Mean
α_i = Effect of feed form
β_j = Effect of oyster mushroom supplementation
$(\alpha\beta)_{ij}$ = Interaction between feed form and oyster mushroom supplementation
Σ_{ijk} = Residual error

Results and Discussion

The main effects of feed forms and oyster mushroom supplementation on growth performance of pullet chickens at chick and grower phases are presented in Table 2.The average feed intake recorded in the chick phase was significantly ($p<0.05$) higher (43.46 g) in birds fed mash than 43.07 g recorded in birds fed pelletized feed. This observation is an indication that birds were comfortable eating mash feed due to its smaller particle size and consequently spent less energy during feeding when compared with their counterparts fed pellets at this stage of production. According to Cerrate*et al.* (2008), young birds select an appropriate feed size according to variation of their oral cavity. Therefore, younger birds prefer a smaller particle size while older ones select a bigger particle size. The values for final weight, average weight gain and average feed intake in the grower phase were significantly ($p<0.05$) higher (1244.69, 11.13 and 106.11g) in birds given pelletized feed and lower (1146.25, 9.27 and 105.08 g) in birds fed mash. These results are in agreement with earlier reported by Abdollahi*et al*. (2011) who indicated that pelleting improves feed intake and weight gain. A better ($p<0.05$) feed conversion ratio (9.53) was also recorded in birds fed pelletized feed than 11.34 recorded in birds fed mash. Similar results were obtained by Chehraghi*et al.,* 2013 who reported that pellets had a better feed efficiency over mash. Kim and Chung (1996) also concluded that feeding poultry crumble-pellets significantly improved feed conversion.

On the other hand, oyster mushroom supplementation had no significant ($p>0.05$) effect on growth performance of pullet chickens. This is in line with the findings by Guo*et al*. (2004) who incorporated similar level of different mushroom powder to broilers diet and concluded that their inclusion had no impact on the birds' performance. The interaction between feed form and oyster mushroom supplementation significantly ($p<0.05$) influenced final weight, average weight gain, average feed intake and feed conversion ratio of pullet chickens at the growers phase (Table 3). Birds fed mash diet with and without oyster mushroom hadlower final weight and average weight gain than values recorded in birds fed pelletized feed with and without oyster mushroom. Average feed intake ranged from 104.77grecorded in birds fed mash without oyster mushroom to 106.19g recorded for birds fed pelletized feed without oyster mushroom. Feed conversion ratio obtained in birds fed mashwithout oyster mushroom was significantly ($p<0.05$) poorer than birds fed pelletized feed with and without oyster mushroom. This further confirms earlier reports by Giannenas*et al*. (2010) that improved performance in poultry can be achieved through dietary supplementation withedible mushroom.

In Table 4, the main effects of feed forms and Oyster Mushroom supplementation on blood lipid profile of pullet chickens at chick and grower phases are presented. Results obtained in the chick phase revealed high density lipoprotein was significantly ($P<0.05$) higher (59.47 mg/dl) in birds fed pelletized feed than 44.35 mg/dl obtained in birds fed mash. Though literature on the impact of feed forms on blood lipid profile of pullet chicken is limited, however, improved HDL in birds fed pellets in this study can be attributed to increased digestibility and improved nutrient intake. According to Fasuyi and Odunayo (2015), enhanced performance in birds fed pellets can be attributed to improved starch digestibility resulting from chemical changes during pelleting, increased nutrient intake, changes in physical form, and decreased energy spent for eating.In addition, low density lipoprotein measured in the grower phase of this study was significantly ($P<0.05$) higher (27.32 mg/dl) in birds fed diets without oyster mushroom than 18.82 mg/dl recorded in birds fed diets supplemented with oyster mushroom. This further confirms previous studies (Khatun*et al*., 2007; Li *et al*., 2007; Willis *et al*., 2007; Khan, 2010; Sogunle*et al.,* 2019), who attributed reduced serum cholesterol and low-density lipoprotein in birds to the hypocholesterolemic effects of some fruiting bodies of edible mushroom.Furthermore, the interaction between feed forms and oyster mushroom supplementation shown in Table 5 had no effect of on blood lipid profile of pullet chickens at chick and grower phases.

CONCLUSION

The study concluded that improved weight gain, feed conversion ratio, andimmunity with reduced low density lipoprotein can be achieved by feeding pullet chickens with pelletized feed supplemented with oyster mushroom.

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Table 1: Percentage composition of experimental diets

*Vitamin A=10,000iu, vitamin D3= 2000iu, vitamin E = 5iu, vitamin K= 2mg, riboflavin= 4.20mg, vitamin B12= 0.01mg, panthothenic acid= 5mg, nicotinic acid= 20mg, folic acid= 0.5mg, choline = 3mg, Magnesium =56mg, Iron= 20mg, Copper= 10mg, Zinc= 50mg, cobalt= 125mg, Iodine= 0.08mg

- = Without Oyster Mushroom+ = With Oyster Mushroom

Ingredients	**Chick (-OM)**	**Chick (+OM)**	**Grower (-OM)**	**Grower (+OM)**
Maize	47.00	47.00	46.20	46.20
Soya bean meal	15.70	15.70	12.00	12.00
Wheat offal	18.00	18.00	26.00	26.00
Groundnut cake	13.60	13.60	10.00	10.00
Dicalcium Phosphate	3.00	3.00	3.00	3.00
Limestone	2.00	2.00	2.00	2.00
Salt (NaCl)	0.25	0.25	0.25	0.25
*Vitamin/mineral premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Oyster Mushroom	-	+	-	+
Total	**100**	**100**	**100**	**100**
Calculated Analysis(%)				
Metabolizable Energy (MJ/kg)	11.34	11.34	11.05	11.05
Crude protein	18.50	18.50	16.50	16.50
Crude fat	4.30	4.30	4.10	4.10
Crude fibre	3.90	3.90	4.20	4.20

Table 2: Main effect of the feed forms and Oyster Mushroom supplementation on growth performance of pullet chickens at chick and grower phases

Parameters	**Feed forms**				**Oyster mushroom supplementation**			
	Mash	**Pelletized**	**SEM**	**P-value**	**-OM**	**+OM**	**SEM**	**P-value**
Chick phase (5 – 8 weeks)								
Initial weight (g/bird)	295.94	310.25	5.71	0.087	307.31	298.88	5.71	0.305
Final weight (g/bird)	627.13	621.56	7.68	0.613	626.31	622.38	7.68	0.720
Average Weight gain (g/day/bird)	15.77	14.82	0.42	0.123	15.19	15.41	0.42	0.721
Average feed intake (g/bird)	43.46[a]	43.07[b]	0.10	0.013	43.30	43.22	0.10	0.569
Feed conversion ratio	2.78	2.94	0.08	0.163	2.89	2.83	0.08	0.619
Grower phase (8 – 16 weeks)								
Initial weight (g/bird)	627.12	621.56	7.68	0.613	626.31	622.37	7.68	0.720
Final weight (g/bird)	1146.25[b]	1244.69[a]	9.97	0.0001	1196.25	1194.69	9.97	0.913
Average Weight gain (g/day/bird)	9.27[b]	11.13[a]	0.25	0.0001	10.18	10.22	0.25	0.881
Average feed intake (g/bird)	105.08[b]	106.11[a]	0.26	0.008	105.48	105.72	0.26	0.514
Feed conversion ratio	11.34[a]	9.53[b]	0.15	0.0001	10.36	10.34	0.15	0.748

[a,b] Means in the same row with different superscripts differ significantly (P<0.05)

Table 3: Interaction effect of the feed forms and Oyster Mushroom supplementation on growth performance of pullet chickens at chick and grower phases

Feed forms	Mash		Pelletized		SEM	P-value
Oyster mushroom supplementation	-OM	+OM	-OM	+OM		
Parameters						
Chick phase (5 – 8 weeks)						
Initial weight (g/bird)	299.38	292.50	315.25	305.25	8.08	0.848
Final weight (g/bird)	630.50	623.80	622.10	621.00	10.90	0.798
Average Weight gain (g/day/bird)	15.77	15.77	14.61	15.04	0.60	0.729
Average feed intake (g/bird)	43.48	43.42	43.12	43.02	0.14	0.876
Feed conversion ratio	2.79	2.77	2.98	2.89	0.11	0.749
Grower phase (8 – 16 weeks)						
Initial weight (g/bird)	630.50	623.70	622.10	621.00	10.90	0.798
Final weight (g/bird)	1140.00^{b}	1152.50^{b}	1253.50^{a}	1237.90^{a}	14.10	0.327
Average Weight gain (g/day/bird)	9.10^{b}	9.44^{b}	11.28^{a}	11.02^{a}	0.36	0.290
Average feed intake (g/bird)	104.77^{b}	105.40^{ab}	106.19^{a}	106.03^{ab}	0.36	0.281
Feed conversion ratio	11.51^{a}	11.17^{a}	9.41^{b}	9.62^{b}	0.21	0.038

^{a,b} Means in the same row with different superscripts differ significantly (P<0.05)

Table 4: Main effect of feed forms and Oyster Mushroom supplementation on blood lipid profile of pullet chickens at chick and grower phases

Parameters	Feed forms				Oyster mushroom supplementation			
	Mash	Pelletized	SEM	P-value	-OM	+OM	SEM	P-value
Chick phase (5 – 8 weeks)								
Triglyceride (mg/dl)	101.80	88.00	10.6	0.409	98.00	91.80	10.60	0.697
Cholesterol (mg/dl)	86.75	99.00	5.35	0.181	93.25	92.50	5.35	0.926
High density lipoprotein (mg/dl)	44.35^{b}	59.47^{a}	2.30	0.010	51.87	51.95	2.30	0.983
Low density lipoprotein (mg/dl)	22.05	19.93	1.34	0.326	19.78	22.20	1.34	0.271
Very low density lipoprotein(mg/dl)	20.35	17.60	2.11	0.409	19.60	18.35	2.11	0.697
Grower phase (8 – 16 weeks)								
Triglyceride (mg/dl)	83.25	75.25	3.98	0.409	78.00	80.50	3.98	0.228
Cholesterol (mg/dl)	90.25	83.25	5.96	0.453	83.25	90.25	5.96	0.453
High density lipoprotein (mg/dl)	47.62	48.02	6.45	0.967	48.82	46.82	6.45	0.837
Low density lipoprotein (mg/dl)	25.97	20.17	2.07	0.119	27.32^{a}	18.82^{b}	2.07	0.044
Very low density lipoprotein (mg/dl)	16.65	15.05	0.80	0.228	15.60	16.10	0.80	0.680

^{a,b} Means in the same row with different superscripts differ significantly (P<0.05)

Table 5: Interaction effect of feed forms and Oyster Mushroom supplementation on blood lipid profile of pullet chickens at chick and grower phases

Feed forms	**Mash**		**Pelletized**		**SEM**	**P-value**
Oyster mushroom supplementation	**-OM**	**+OM**	**-OM**	**+OM**		
Parameters						
Chick phase (5 – 8 weeks)						
Triglyceride (mg/dl)	107.50	96.00	88.50	87.50	14.90	0.743
Cholesterol (mg/dl)	90.00	83.50	96.50	101.50	7.56	0.489
High density lipoprotein (mg/dl)	46.05	42.65	57.70	61.25	3.25	0.346
Low density lipoprotein (mg/dl)	22.45	21.65	17.10	22.75	1.90	0.165
Very low density lipoprotein (mg/dl)	21.50	19.20	17.70	17.50	2.99	0.743
Grower phase (8 – 16 weeks)						
Triglyceride (mg/dl)	76.50	90.00	79.50	71.00	5.62	0.122
Cholesterol (mg/dl)	88.50	92.00	78.00	88.50	8.43	0.699
High density lipoprotein (mg/dl)	53.60	41.65	44.05	52.00	9.13	0.337
Low density lipoprotein (mg/dl)	19.60	32.35	18.05	22.30	2.93	0.221
Very low density lipoprotein (mg/dl)	15.30	18.00	15.90	14.20	1.12	0.122