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RESPONSE OF TWO STRAINS OF BROILER CHICKENS TO OYSTER MUSHROOM (*PLEUROTUS OSTREATUS*) EXTRACT IN THE TROPICS

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Abstract

This study was aimed to determine the influence of *Pleurotus ostreatus* on response of broiler chicken. One hundred and eighty day-old broiler chicks (90 each of Cobb and Marshall strain) were administered extract of *Pleurotus ostreatus* at 0, 2000 and 4000 mg/litre water. Data were collected on performance, carcass attributes, faecal oocyte per gram (OPG) and caecum microbial (CM) population. At day 28, strain had effect ($p < 0.05$) on feed: gain (F:G) with better value observed in Cobb. At day 56, Cobb had higher ($p < 0.05$) final weight (FW), total weight gain (TWG) and daily weight gain (DWG) with lower F:G. Highest ($p < 0.05$) FW and lower F:G were observed in birds administered 2000 and 4000 mg l^{-1}. Interaction had effect ($p < 0.05$) on FW, TWG, DWG and F:G with best value observed in Cobb administered 4000 mg l^{-1}. Cobb recorded higher ($p < 0.05$) dressed weight (DW%), breast% and thigh%. Increasing *Pleurotus* level resulted in highest DW% and breast in both strains. OPG and CM was lowest at 4000 mg l^{-1} in both strains. The study therefore concluded that for optimal performance, *Pleurotus* can be administered at 4000 mg l^{-1}.

Introduction

Conventionally, control and treatment of poultry diseases is based on the use of synthetic products but the increasing trend of antimicrobial resistance calls for the need of having alternative approaches to manage-

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ment of poultry diseases. Antimicrobial resistance, cost and availability of the conventional medicines and residues in animal products and the environment are the major challenges in the poultry industry in developing countries. As the consequences of these problems, people in rural communities have continued to use indigenous plants as a convenient alternative for control and treatment of diseases (BAKARI et al. 2012, EKUNSEITAN et al. 2016a,b). In most cases, plants are used for treatment in their crude forms without known or determined concentration, established dosages and known side effects to treated subjects.

Mushroom have been reported to have immune enhancing and stress-reducing properties (DALLOUL and LILLEHOJ, 2006, BORCHERS et al. 2008) which is a necessary requirement for perfect biological processes. Oyster mushroom (*Pleurotus ostreatus*) is one of the commonly cultivated mushroom spices and its antiviral and anticancer properties ascertained (BOBEK and GALBAVY 2001). Additionally, several medicinal mushrooms have demonstrated powerful antioxidant activities (MINARECI et al. 2011, LIU et al. 2013) likewise antibacterial potentials (EKUNSEITAN et al. 2018) and, as a consequence, have potential application as natural growth and health enhancing agent. Mushroom (Shiitake: *Lentinus edodes*) extract contains substrates capable of increasing the population of important bacteria (bifidobacteria and lactobacilli) (GUO et al. 2004)

It has been reported that the microbial communities in the gastrointestinal track of poultry are influenced by a number of factors including stocking density, diet, feeding practices, housing conditions, age of birds and pathogens (TOROK et al. 2007). Also it is very well established that bacterial communities change radically between the different anatomical segments of the digestive tract. The use of synthetic drugs has been implicated in the decimation of important microbes e.g in the gut of birds which are necessary for proper biological functions. Increase in pathogenic microbial substances due to gap in the intestinal immune system may lead to antagonistic reactions to nutrients and tolerance to pathogens. Intestinal microbial profile can be modified and affected by the diet, phytobiotics and changes in dietary composition (YEGANI and KORVER 2008). Therefore, the maintenance of health of intestinal ecosystem is highly essential for optimal health and growth of animals.

Although researches have been conducted on the influence of intensive growth of mushrooms with various cellulosic substrates which, after fruiting remains as a source of protein that can be used to feed livestock strategies. A possible strategy in reducing the presence of pathogenic microbe shedding in final products from poultry is the possibility of using or ascertain its antibacterial potentials (EKUNSEITAN et al. 2018) of *Pleurotus ost-*

reatus in decreasing their populations in the gut. However, documented information on the use of *Pleurotus* spp. as regards to its effect on broiler performance and carcass characteristics is limited in the tropics where the growth of bacteria is highly favoured. This research work was directed towards investigating the influence of *Pleurotus* spp. on growth performance indices and carcass characteristics when orally administered to broiler chickens at different levels of concentration.

Materials and Method

The experiment was carried out at the Poultry unit of the Teaching and Research Farms, Federal University of Agriculture, Alabata, Abeokuta, Ogun state, Nigeria. The Farm lies within latitude 7 10 N. Longitude 3 2 E and altitude 76 mm (*Google maps* 2018).

A 1 kg of fresh oyster mushroom was soaked with 2litres of ethanol at a ratio of 1:2 and was left for 3 days (72 hours) for extraction. After 72 hours, the extract was sieved out using a muslin cloth. The extract was clarified by filtration through celite on water pump and then concentrated in vacuo using a rotation evaporator.

One hundred and eighty day old broiler chicks of two strains (90 each of Cobb and Marshall Strain) were used for this experiment. Birds were raised under intensive management system. Variation in this research was based on two (2) factors; strain type (Cobb and Marshall) and levels of oral administration of *Pleurotus ostreatus* mushroom extract: 0 for control, 2000 and 4000 mg l^{-1} of water. Each strain was allotted to the three levels of administration of *Pleurotus ostreatus* containing 30 birds per treatment and further divided into replicates of 10 birds each. The extract of *Pleurotus ostreatus* was administered via water once in a week at the stated levels. Vaccination was given to all treatment while medication (antibiotics and coccidiostat) was administered only to the control group.

The birds were given starter diet up to four weeks of age (crude protein: 22%, metabolizable energy [kcal kg^{-1}]: 3000, fibre [%]: 3.5, fat [%]: 6.00) and 29–56days (crude protein: 19%, metabolizable energy [kcal kg^{-1}]: 2900, fibre [%]: 3.5, fat [%]:4.00). Fresh feed and water was provided on a daily basis. Data on performance parameters were taken on weekly basis.

At the 56th day, two birds from each replicate with weight closest to the mean of the group was selected. Selected birds were starved for 12 hours. The birds were slaughtered via neck slit and properly bled, plucked and eviscerated. The cut-up parts and Organs were weighed using a sensitive scale and were expressed as percentages of the live weight.

Caecum was removed at the 56th day from slaughtered birds and placed in a sample tube. Estimation of total bacteria count in the gut sample while bacteria identification was carried out according to COWAN and STEEL method (2004) using morphological and biochemical tests.

Triplicate fresh feaces (5 g) were collected randomly from each replicate at 56 days of age using swab sticks Oocyst count was determined out using McMaster egg-counting technique (HAUG et al. 2006).

Data obtained was arranged in a 2 x 3 factorial layout and analyzed using the General Linear Model of SAS. Differences amongst groups were determined using Duncan's multiple-range test while statistical significance were based on $P < 0.05$.

Results

The effects of strain and oral administration of *Pleurotus ostreatus* (oyster mushroom) extract on the growth performance of broiler chickens at starter phase is shown in Table 1. All parameters considered were not

Table 1

Main effects of strain and oral administration of *Pleurotus ostreatus* (oyster mushroom) extract on growth performance of broiler chickens at starter phase (0–4weeks)

Strain					*Pleurotus ostreatus*					
Parameter	Marshall	Cobb	SEM	P-Value	control	2000 mg l^{-1}	4000 mg l^{-1}	SEM	P-Value	S x PE
Initial weight [g/bird]	36.45	38.36	0.08	0.300	37.39	37.44	37.39	0.44	0.937	NS
Final weight [g/bird]	795.68	824.69	10.38	0.085	806.48	810.19	813.89	14.94	0.839	NS
Total weight gain [g/bird]	759.28	786.33	11.31	0.105	769.10	772.75	776.50	14.77	0.840	NS
Daily weight gain [g/day]	108.46	112.33	1.62	0.105	109.87	110.39	110.93	2.11	0.840	NS
Total feed intake [g/bird]	1334.48	1325.70	4.50	0.536	1326.92	1326.88	1336.47	4.44	0.484	NS
Daily feed intake [g/day]	47.66	47.35	0.16	0.536	47.39	47.39	47.73	0.16	0.484	NS
Feed to gain	1.76^a	1.69^b	0.02	0.042	1.73	1.72	1.72	0.03	0.897	NS

$^{a, b}$ – Means in the same rows by factor with different superscripts differ significantly ($P < 0.05$)
SEM – standard error of means
S x PE – strain and *Pleurotus ostreatus* interaction
NS – not significant

influenced ($p > 0.05$) by strain except feed: gain. The feed to gain (FCR) was lower and thus, better in the Cobb strain (1.69). It was observed that final weight (816.67 g/bird), total weight gain (778.53 g/bird) and daily weight gain (111.19 g/bird) values were numerically higher in the Cobb strain. The effect of oral administration of *Pleurotus ostreatus* (oyster mushroom) on growth performance of broiler chickens at starter phase revealed no significant ($p > 0.05$) effect. However, the final weight, total weight gain and daily weight gain were numerically higher in the 4000 mg l^{-1} dosed group. The interactive effect between strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) had no effect ($P < 0.05$) on growth performance indices of broiler chickens at starter phase.

Table 2

Main effects of strain and oral administration of *pleurotus ostreatus (*Oyster mushroom) extract on growth performance of broiler chickens at finisher phase

Strain					*Pleurotus ostreatus*					
Parameter	Marshall	Cobb	SEM	P-Value	control	2000 mg l^{-1}	4000 mg l^{-1}	SEM	P-Value	S x PE
Initial weight [g/bird]	795.68	824.69	10.98	0.094	806.48	810.19	813.89	15.45	0.931	NS
Final weight [g/bird]	2278.09^b	2549.38^a	27.51	<.0001	2352.78^b	2443.98^a	2444.44^a	6.39	0.046	S
Total weight gain [g/bird]	1482.41^b	1724.69^a	30.33	<.0001	1546.30	1633.80	1635.56	60.62	0.124	S
Daily weight gain [g/day]	52.94^b	61.59^a	1.08	<.0001	55.22	58.35	58.23	2.16	0.124	S
Total feed intake [g/bird]	4283.49	4282.72	13.99	0.972	4275.00	4308.56	4265.74	17.72	0.276	NS
Daily feed intake [g/day]	152.98	152.95	0.49	0.972	152.68	153.88	152.35	0.63	0.276	NS
Feed to gain	2.89^a	2.49^b	0.05	<.0001	2.78^a	2.65^b	2.65^b	0.10	0.040	S
Mortality [%]	0.11	0.00	0.06	0.337	0.00	0.17	0.00	0.06	0.397	NS

$^{a, b}$ – Means in the same rows by factor with different superscripts differ significantly ($P < 0.05$)
SEM – standard error of means
S x PE – strain and *Pleurotus ostreatus* interaction
NS – not significant

Table 2 shows the effects of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on the growth performance of broiler chickens at finisher phase. Final weight, total weight gain, daily weight gain and feed conversion ratio were significantly ($P < 0.05$) affected by strain type. The final weight (2549.38 g/bird), total weight gain (1724.69 g/bird) and daily weight gain (61.59 g/bird) values were higher in Cobb strain. The feed to gain (FCR) was higher in the Marshall strain (2.89). Total feed intake value was slightly higher in the Marshall strain (4283.49 g/bird).

The oral administration of *Pleurotus ostreatus (*oyster mushroom) extract had no significant effect ($P > 0.05$) on the growth parameters of broiler chickens measured except final weight and feed: gain. The observed final weight was highest (2444.44 g/bird) in birds administered 4000 mg l^{-1} administration level and lowest in the control groups. However, numerically feed to gain (FCR) value observed was similar and best in 2000 mg l^{-1} and 4000 mg l^{-1} groups but highest (2.78) in the control group.

The interactive effect between strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on growth performance indices of broiler chickens at finisher phase is presented in Table 3. The interactive

Table 3

Interactive effect of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on growth performance parameters of broiler chickens at finisher phase

Strain	Marshall			Cobb				
Pleurotus ostreatus	control	2000 mg l^{-1}	4000 mg l^{-1}	control	2000 mg l^{-1}	4000 mg l^{-1}	SEM	P-Value
Parameter								
Initial weight [g/bird]	781.48	785.19	820.37	831.48	835.19	807.41	18.39	0.219
Final weight [g/bird]	2238.89^{d}	2325.00^{d}	2270.37^{d}	2466.67^{c}	2562.96^{b}	2618.52^{a}	37.70	0.017
Total weight gain [g/bird]	1457.41^{e}	1539.81^{d}	1450.00^{e}	1635.19^{c}	1727.78^{b}	1811.11^{a}	38.42	0.035
Daily weight gain [g/day]	52.05^{d}	54.99^{c}	51.79^{d}	58.39^{bc}	61.71^{ab}	64.68^{a}	1.04	0.040
Total feed intake [g/bird]	4261.11	4337.50	4251.85	4288.89	4279.63	4279.63	20.67	0.219
Daily feed intake [g/day]	152.18	154.91	151.85	153.18	152.84	152.84	0.74	0.219
Feed to gain	2.94^{a}	2.82^{b}	2.94^{a}	2.62^{b}	2.48^{c}	2.37^{d}	0.08	0.029
Mortality [%]	0.00	0.33	0.00	0.00	0.00	0.00	0.06	0.397

$^{a, b, c, d, e}$ – Means in the same rows by factor with different superscripts differ significantly ($P < 0.05$)
SEM – standard error of means

effect had influence ($P < 0.05$) on final weight, total weight, daily weight gain and feed to gain. Final weight, total weight gain and daily weight values increased in Cobb strain with increasing level of administration of *Pleurotus ostreatus* with the highest weight observed at 4000 mg l^{-1}. Feed to gain ratio decreased with increasing *Pleurotus ostreatus* administration in Cobb with lowest and best feed to gain ratio observed in cobb strain on 4000 mg l^{-1}.

Table 4 shows the effects of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on carcass characteristics of broiler chickens. Live weight, dressed weight, kidney: live weight, liver: live weight breast, thigh, head and the following organs; liver, kidney, gizzard, and spleen were significantly ($P < 0.05$) affected by strain. The dressed weight observed was greater in the Cobb strain (73.36 g). The Cobb strain also

Table 4

Main effects of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on carcass characteristics of broiler chickens

Parameter	Strain				*Pleurotus ostreatus*					
	Marshall	Cobb	SEM	P-Value	control	2000 mg l^{-1}	4000 mg l^{-1}	SEM	P-Value	S x PE
Live weight [g]	2255.56^b	2555.56^a	31.07	<.0001	2350.00	2425.00	2441.67	75.62	0.245	NS
Dressed weight [%]	68.02^b	73.36^a	0.61	<.0001	70.84	70.56	70.68	1.36	0.967	S
Back [%]	13.87	13.79	0.23	0.807	13.64	13.85	13.99	0.27	0.713	NS
Breast [%]	19.53^b	24.61^a	0.65	<.0001	22.19	22.28	22.74	1.36	0.865	S
Thigh [%]	10.59^b	11.41^a	0.24	0.044	10.40	10.83	11.87	0.34	0.500	NS
Drumstick [%]	9.96	10.04	0.23	0.805	9.96	9.70	10.34	0.28	0.356	NS
Wings [%]	7.77	7.83	0.14	0.727	7.52	7.90	7.98	0.15	0.138	NS
Neck [%]	5.77	5.31	0.22	0.193	5.77	5.56	5.28	0.28	0.501	NS
Liver [%]	2.10^a	1.72^b	0.09	0.015	1.86	1.89	1.80	0.14	0.785	S
Kidney [%]	0.52^a	0.37^b	0.04	0.044	0.45	0.42	0.41	0.06	0.836	NS
Gizzard [%]	1.67^a	1.43^b	0.07	0.043	1.52	1.62	1.51	0.10	0.69	NS
Heart [%]	0.5	0.43	0.02	0.064	0.49	0.46	0.44	0.03	0.494	NS
Abdominal fat [%]	2.26	1.81	0.17	0.089	1.73	2.18	2.19	0.22	0.244	NS
Spleen [%]	0.12^a	0.07^b	0.01	0.0004	0.11	0.09	0.09	0.01	0.296	S

$^{a, b}$ – Means in the same rows by factor with different superscripts differ significantly ($P < 0.05$)
All parameters are expressed as a percentage of the live-weight
SEM – standard error of means

recorded greater breast, thigh and drumstick weights (24.61g, 11.41g and 10.04 g respectively). Back, shank, wings, neck and liver: spleen weights' values observed were comparable between both strains.The oral administration of *Pleurotus ostreatus* (oyster mushroom) extract at different levels had no significant effect ($P > 0.05$) on all carcass characteristics of broiler chickens across all treatment groups. Although not significant, observed live weight improved with increasing administration levels with the highest value (2441.67 g) recorded in 4000 mg l^{-1}. Breast weight values were comparable in control and 2000 mg l^{-1} administration level.

Table 5

Interactive effect of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on carcass characteristics of broiler chickens

Strain	*Marshall*			*Cobb*				
Pleurotus ostreatus	control	2000 mg l^{-1}	4000 mg l^{-1}	control	2000 mg l^{-1}	4000 mg l^{-1}	SEM	P-Value
parameter								
Live weight [g]	2283.33	2300.00	2183.33	2516.67	2566.67	2583.33	51.99	0.872
Dressed weight [%]	67.69^{c}	68.97^{c}	67.39^{c}	72.38^{b}	73.42^{a}	74.29^{a}	0.97	0.0320
Back [%]	14.11	13.94	13.57	14.05	13.59	13.71	0.38	0.691
Breast [%]	18.87^{c}	19.12^{c}	20.61^{b}	22.87^{b}	25.69^{a}	25.67^{a}	1.04	0.011
Thigh [%]	10.63	10.41	10.74	11.32	11.03	11.87	0.40	0.708
Drumstick [%]	9.97	9.85	10.05	10.83	9.44	9.87	0.35	0.220
Wings [%]	7.79	8.05	7.46	7.91	8.01	7.58	0.21	0.736
Neck [%]	5.84	5.54	5.93	5.03	5.28	5.62	0.39	0.953
Liver [%]	2.21^{a}	2.06^{ab}	2.05^{ab}	1.89^{ab}	1.57^{b}	1.68^{ab}	0.15	0.0392
Kidney [%]	0.48	0.57	0.52	0.37	0.36	0.37	0.06	0.879
Gizzard [%]	1.80	1.55	1.66	1.48	1.43	1.38	0.12	0.522
Heart [%]	0.49	0.45	0.57	0.44	0.43	0.42	0.03	0.336
Abdominal fat [%]	2.42	2.59	1.76	1.79	1.94	1.69	0.28	0.486
Spleen [%]	0.12^{a}	0.10^{a}	0.10^{a}	0.09^{b}	0.07^{b}	0.07^{b}	0.01	0.00813

$^{a, b, c, d}$ – Means in the same rows by factor with different superscripts differ significantly ($P < 0.05$)
All parameters are expressed as a percentage of the live weight
SEM – standard error of means

Table 5 shows the interactive effect of strain and oral administration of *Pleurotus ostreatus* (Oyster mushroom) on carcass characteristics of broiler chickens. The interactive effect had no influence ($P > 0.05$) on all parameters considered. Increasing level of *Pleurotus ostreatus* administration

resulted in higher live weight and dressing percentage in both strains. Increase in breast [%] was observed in Cobb strain statistically similar values in 2000 mg l^{-1} and 4000 mg l^{-1} groups. Cobb strain had the lowest values for spleen in the 2000 mg l^{-1} and 4000 mg l^{-1} groups.

Table 6

Main effect of stains and varying levels of *Pleurotus ostreatus* on Oocyst Per G of Broiler birds

Parameter	Strains				*Pleurotus ostreatus*				
	Marshall	Cobb	S.E.M	P-value	0	2000	4000	SEM	P-value
OPG [10^6cfu ml^{-1}]	83.33	50.00	24.49	0.25	100.00^a	87.50^b	12.50^c	21.94	0.007

^{a,b,c} – Means with different superscripts along the same row are significantly different ($p \leq 0.05$)
SEM – standard error of means

Main effect of strain and varying levels of *Pleurotus ostreatus* on OPG is presented in Table 6. The strain types had no significant ($p > 0.05$) effect on the OPG of the excreta of the birds at week 8. However, Cobb strain recorded lower OPG value ($p > 0.05$) compared to the Marshall strain. Varying levels of administration *Pleurotus ostreatus* had significant effect ($p < 0.05$) on OPG of birds. A continuous reduction in OPG value was observed as the level of administration increased with the lowest value

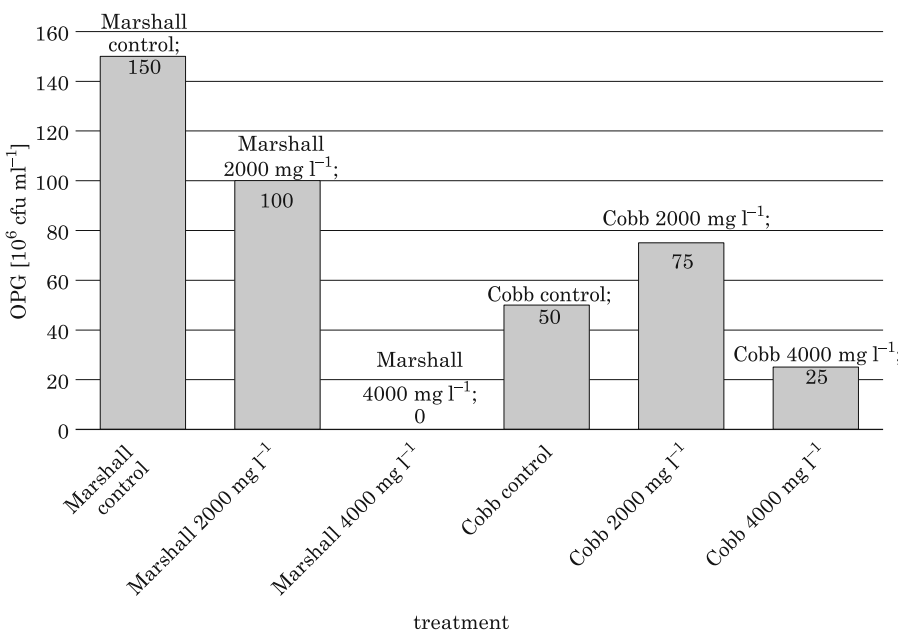

Fig. 1. Interactive effect of strains and varying levels of *Pleurotus ostreatus* on OPG of broiler chickens

recorded in birds administered 4000 mg l^{-1} *Pleurotus ostreatus* while the highest was recorded in the control group.

Figure 1 shows the Interactive effect of strains and varying levels of *Pleurotus ostreatus* on OPG of broiler chickens. Gradual decrease was observed as level of administration of Pleurotus ostreatus increased in Marshall Strain. Lowest OPG values was recorded in Marshall and Cobb strain administered 4000 mg l^{-1} *Pleurotus ostreatus*.

Effects of strains and varying levels of *Pleurotus ostreatus* on Microbiota population caecum of broiler chickens (week 8) is presented in Table 7. The strain type had no significant ($p > 0.05$) effect on the microbiota population. *Pleurotus ostreatus* was observed to significantly ($p < 0.05$) affect the microbiota population of the caecum. Highest ($p < 0.05$) microbiota population in caecum was recorded in birds administered 0 mg l^{-1} and 2000 mg l^{-1} *Pleurotus ostreatus*. Interactive effect of Strain and varying levels of *Pleurotus ostreatus* on microbiota population of the caecum of broiler chickens revealed significant ($p < 0.05$) differences in the values of microbiota population recorded. The lowest population was observed in 4000 mg l^{-1} in both strain.

Table 7

Effects of strain and varying levels of *Pleurotus ostreatus* on microbiota population of the caecum of broiler chickens (week 8)

Parameters	Strains				*Pleurotus ostreatus*				
	Marshall	Cobb	S.E.M	P-value	0	2000	4000	S.E.M	P-value
Caecum [10^6cfu ml^{-1}]	0.90	1.22	0.27	0.23	1.43^a	1.43^a	0.33^b	0.19	0.01
Strain	Marshall				Cobb				
Pleurotus ostreatus	0	2000	4000	0	2000	4000	S.E.M	P-value	–
Caecum [10^6cfu ml^{-1}]	1.10^b	1.40^b	0.20^c	1.75^a	1.45^b	0.45^c	0.21	0.006	–

^{a,b,c} – Means with different superscripts along the same row are significantly different ($p \leq 0.05$)
cfu – colony-forming unit

Discussion

Strain affected feed to gain significantly with the Cobb strain consuming lower feed quantity daily and in total to gain more weight daily and in total consequently reaching higher final weight of and also lower and better feed to gain value within the pair at the end of the starter phase. At the end of the starter phase, administration of *Pleurotus* extract nume-

rically improved the performance of the birds as the bird in the 2000 and 4000 mg l^{-1} group recorded higher daily and total weight gain to attain greater final weights and recording numerically similar and better feed to gain values than the control group with the 2000 mg l^{-1} group consuming the least quantity of feed among the treatment groups. These outcomes synchronize with the reports of (KABIR et al. 2004, SAMLI et al. 2007) that feeding of probiotics options to broiler birds cumulates to improvement in growth performance and feed efficiency and also the reports of (NAHANSHON et al. 1992) that the means of action of probiotics in poultry include improving feed intake and digestion.

Strain effect was noticeable in the performance of the birds at the finisher phase particularly in Cobb strain which demonstrated better feed utilization resulting in substantially higher final weight, daily and total weight gain while consuming lesser quantity of feed than the Marshall. This is a reflection of considerable individual variations which is a consequence of type and feed ingested, species and breed (KOKOSZYNSKI et al. 2017) as genetic variations in broiler lines affects the rates of development of intestinal tracts and likewise the digestion potentials. These differences accounts for the distinctions observed in some performance indices of the two strains.

The oral administration of *Pleurotus ostreatus* extract positively impacted the final weight and feed to gain values of the birds at the finisher phase. Observable increase in the final weight, total weight gain and daily weight values as well as the similar but better feed to gain values of the birds in both 2000 and 4000 mg l^{-1} group can be associated with improvement in the growth performance of birds administered *Pleurotus ostreatus* extract. These results indicates improvement in growth performance and feed efficiency of broiler chickens prompted by the direct action on improving feed intake and digestion analogous to probiotic mode of action postulated by NAHANSHON et al. (1992). This mode of activity has been posited (TOGHYANI et al. 2012) to be the decimation of gut microbial load which results in improvement in animal's utilization of nutrients from diets fed resulting in feed efficiency and enhancement of growth.

At the finisher phase, the final weight, total weight gain, daily weight gain and feed to gain of the birds were influenced by the interaction of strain and oral administration of *Pleurotus* extract with no particular trend observed in the combination of Marshall Strain and *Pleurotus ostreatus* extract across all treatment groups. The interaction of *Pleurotus ostreatus* extract and Cobb strain displayed a noticeable development as seen in the increasingly changing final weight, total and daily weight gain values and better values of feed to gain with declining total and daily feed

intake from the control group to the 4000 mg l^{-1} group. These trends indicate a better performance outcome of birds administered *Pleurotus ostreatus* extract at both 2000 and 4000 mg l^{-1} treatment groups compared to the control group. These outcomes support the theory of (AWAD et al. 2009) that the efficacy may be potentiated by several approaches: the selection of more efficient strains, combination of probiotics and synergistically acting components of mushrooms (EKUNSEITAN et al. 2017). These differences accounts for the distinctions observed in some performance indices of the two strains.

Strain effect was evident on some carcass traits such as Live weight and dressed weight percentages, cut-up parts and organs. The Cobb strain indicated lower organ relative to live weight. Cut-up parts which are economically important components of carcass were of higher percentages in the Cobb than the Marshall. Similar observation was put forward by SANDERCOCK et al. (2009) of strain direct effect on carcass attributes. The oral administration of *Pleurotus ostreatus* extract had no influence any of the carcass characteristics considered. Although cut-up parts increased numerically as level of administration increased. The interactive relationship of strain and *Pleurotus ostreatus* extract brought about improvement in the dressed weight percentage, breast percentage of body weight as well as lesser organ weights with increase in administration of *Pleurotus ostreatus* extract. The non-significant effect observed in organ percentages indicate no health issue, denoting no overload on the functions of these organs and therefore pose a threat to health of animals. The 2000 and 4000 mg l^{-1} groups of both strains had better breast weight compared to their control groups. This portrays better carcass production when *Pleurotus ostreatus* extract is administered as the breast is the meatiest part of chicken however, the Cobb strain recorded the higher breast percentages between both strains.

The reduction in OPG observed with increase in *Pleurotus ostreatus* possibly indicate that the prophylactic efficacy of *Pleurotus ostreatus* in reducing *Eimeria* oocysts with increased inclusion level. This is possible by binding and removing pathogens from the intestinal tract resulting thereby in better intestinal tract integrity and stimulation of animal's immune system (YEGANI and KORVER, 2008, TOGHYANI et al. 2012) as *Eimeria* multiplication in the intestinal tract causes hemorrhagic tissue damage results in mortality, disruption of digestive processes, depressed weight gain, and vulnerability to other disease causing organisms (MC DOUGALD and FITZ-COY 2008). Since there exist a direct relationship between oocysts concentration and lesion development, a reduction in oocyst counts will help in curtailing the incidence of severe intestine

lesions or eroding of absorption sites resulting in better improvement in broiler growth performance. This positive observation may suggest that parasite reproductive status has been compromised by the administration of *Pleurotus ostreatus*, leading to the possible reduction in the production of trypsin and bile in the duodenum responsible for activation and release of its sporozoites (JORDAN et al. 2011).

Microbes in the GIT is subdivided into pathogenic or beneficial groups, pathogenic bacteria causes systemic infections, intestinal putrefaction, and toxin formation. The identified microbes in the study were harmful bacterial and their population was greatly reduced in both strain at the highest level of administration. *Pleurotus ostreatus* administration demonstrated similar ability as probiotics (JEURISSEN et al. 2002) in offering protection from gut pathogenic organisms. This is also supported by study conducted by EKUNSEITAN et al (2018) which demonstrated the ability of *Pleurotus ostreatus* in inhibiting *in vitro* growth of enteric pathogens. And as widely emphasized a good gut health leads to positive production attributes. This will also help in reducing the shedding of microbes in flesh of meat during processing

The use of *Pleurotus ostreatus* can serve as an option in replacing conventional and growth promoting drugs as indicated by its ability improving feed to gain thereby resulting in better growth in Cobb strain up to 400 mg l^{-1} and 2000 mg l^{-1} in Marshall. Likewise, *Pleurotus ostreatus* should be administered at 4000 mg l^{-1} for reduction of caecal pathogenic population and bacterial organisms in both Marshall and Cobb broiler chicken strains.

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