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Effect of inclusion levels and withdrawal periods of Tetracin® on growth performance, carcass traits and occurrence of residues in meat-type chickens

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Target Audience: Animal/Meat Scientists, Livestock farmers, Regulatory Agencies and Consumers

Abstract

The study investigated the effect of inclusion levels and withdrawal periods of Tetracin on growth performance, carcass trait and occurrence of residues in meat type chickens raised in a tropical environment. Tetracin® a feed grade antibiotic was administered at 0, 50, 100, 150 and 200mg/kg of feed (starter and finisher diets) with observation of different withdrawal periods (0, 7 and 15 days each) for 6 weeks using a 3x5 factorial layout. One hundred and fifty (150) two weeks old broiler chicks (Anak strain) were randomly divided into five treatments of thirty birds each and three replicates of ten birds. The broilers were fed between 2-4 weeks of age on the starter diet and 4-8 weeks of age on finisher diets, while antibiotic withdrawal was practiced at 15, 7 and 0 day respectively for each inclusion level. Performance (feed intake, weight gain and feed: gain ratio) was monitored while six broilers per treatment were used for carcass and organ evaluation. At the end of feeding trial, microbial assay method was used to detect antibiotic residues on samples from breast, thigh, kidney and liver from two birds per treatment. Data on performance and carcass evaluation were analysed using one-way analysis of variance and significant means separated at 5% level of probability. The final body weight (FBW), total body weight gain (TBWG), total feed intake (TFI), plucked weight (PW), eviscerated weight (EW) and dressing percentage of birds increased progressively (P<0.05) as Tetracin® was added at 50mg/kg -150mg/kg with a decline at 200mg/kg which was still significantly better than birds on control treatment. Broilers fed 150mg Tetracin/kg diet recorded significantly heaviest (P<0.05) thigh (12.86%), *breast (20.89%) and drumstick (12.78%). Increase in withdrawal period resulted in reduced weights of carcass cut up parts. Liver weights increased ($P<0.05$) with level of Tetracin but decreased ($P<0.05$) with increase in withdrawal period. The interaction showed significant differences ($P<0.05$) in the liver, lung and whole gizzard along the inclusion level of the antibiotic and across its withdrawal periods. Residue was found in the thigh, liver and kidney when Tetracin® was added at 100mg/kg -200mg/kg and subsequently present in the liver at 15day withdrawal period with 200mg/kg inclusion level. Residue was only found in the thigh muscle when withdrawal time was not observed. The study showed that strict adherence to label dosage and withdrawal time should be followed to mitigate the presence of feed grade antibiotic residues in broiler meat among the consuming public.*

Keywords: Tetracin®; Growth; Carcass; Primal cuts; Organs; Residue; Broiler

Description of Problem

Antibiotics are used in food animals to treat clinical diseases, prevent and control common diseases, and to enhance animal growth (1). The different applications of antibiotics in food animals have been described as therapeutic, prophylactic, and for sub-therapeutic use. However, these various uses are frequently indistinct as they are often applied concurrently in livestock populations (2)

In pigs and broilers, antimicrobials are mainly administered to control the gut flora. In that way, producers try to prevent the onset of sub-clinical infections and the misuse of the nutrients provided by the feed. Most of the antibiotics used in poultry production are administered in drinking water and/or in feed. It was reported that following administration, these drugs are rapidly absorbed from the gastrointestinal tract of the chicken (3)

Nisha (4) stated that antibiotics may produce improved growth rate because of thinning of mucous membrane of the gut, facilitating better absorption, altering gut motility to enhance better assimilation, producing favorable conditions to beneficial microbes in the gut of animal by destroying harmful bacteria and partitioning proteins to muscle accretion by suppressing monokines. Antibiotics also favor growth by decreasing degree of activity of the immune system, reduced waste of nutrients and reduce toxin formation. In most of the cases only young growing animals and poultry are responsive to antibiotic mediated growth promotion (4).

Failure to adhere strictly to the withdrawal period in poultry production is reported to be the primary cause of antibiotic residues in edible tissue, liver, kidney and poultry product like egg (2, 5). Withdrawal period is defined as the time required for 99% of the birds in the population (treated according to labeled instructions) to be free of the drug residues above the tolerant level. These periods vary according to the drug used, dosage, route of administration and animal species. Earlier work by Akinwumi *et al.* (2) showed that most farmers (91%) in Nigeria are aware of the withdrawal period but with low adherence (54%), which is a concern to local and international regulatory and public health agencies.

Many reports indicated that microbial resistance to antibiotics may arise as a result of animal exposure to these agents and that the resistance may possibly be transferred to human beings (6). In addition, human exposure to animal products containing significant level of antibiotic residues may provoke immunological response in susceptible individuals and cause disorder of intestinal flora (7, 8).

The present study is aimed at evaluating the impact of varying inclusion levels and withdrawal period of Tetracin® (feed grade antibiotic) on growth performance, carcass and organ characteristics and occurrence of residue in broiler chicken.

Material and Methods

A 6- week experiment was conducted with 150, 2 week old (Anak Strain) broiler chicks that were randomly assigned to 5 experimental treatments (3 replicates of 10 birds each) representing 5 graded levels of veterinary antibiotic Tetracin®. Tetracin® a tetracycline based antibiotics was bought at a reliable veterinary store in Ogbomoso and administered through conventional broiler starter (CP – 23%, ME 3000kcal/kg) and finisher (CP – 20%, ME 2900kcal/kg) diets at 0, 50, 100, 150 and 200 mg/kg inclusion levels to represent T1, T2, T3, T4 and T5 respectively.

The withdrawal period was observed for 15 days, 7 days and 0 day prior to slaughtering i.e the feed grade antibiotic was stopped for selected birds across the treatments for 15 days, 7 days and 0 day prior to slaughter. Fifteen days was the actual label withdrawal period for Tetracin®.

Data Collection

Performance characteristics:

Initial body weights of the birds were taken on replicate basis at the start of the study when the birds were two weeks old and thereafter on weekly basis. Weekly feed intake was also recorded. The average weight gain, total feed intake and feed to gain ratio were calculated from the data obtained during the overall experimental period.

Carcass Characteristics

At the end of the feeding period, six birds from each treatment with various withdrawal period groups were taken at random for carcass analysis. The birds were starved overnight with ample supply of drinking water. The birds were slaughtered by cutting through the jugular vein and carotid artery to allow for quick bleeding before scalding (9, 10). Data were collected on live weight (weight of the live bird), fasted weight (weight of the live bird starved of feed overnight before slaughtering), bled weight (weight of slaughtered animal when the blood is fully drained), plucked weight (weight of the slaughtered animal after its feather has been removed), eviscerated weight (weight of the animal after its internal organ has been removed) and dressed weight. All these are done with the help of a sensitive weighing scale and the weights were expressed as percentages of live weight. Primal cuts (breast, drumstick, back, thigh and wings) were weighed and expressed as percentages of the live weight. Internal organs (kidney, liver, spleen, heart and gizzard) were weighed separately and each expressed as percentage of live weight.

Antimicrobial Residue Detection

Samples of breast, thigh, kidney and liver from two birds from each treatment (both inclusion and withdrawal period) were tested for antibiotic residue. Microbial assay was used for detection of antibiotics, specifically Agar diffusion method, which involved the use of bacterial *Bacillus subtillis*. A modification of the method described by Katz and Fassbender (11) was adopted.

Data Analysis:

Data obtained were subjected to analysis of variance (ANOVA) using the General Linear Model for factorial within a completely randomized design of (12) and (13). Means were separated by Duncan's range option of the same statistical software.

Results

Growth performance

The effect of experimental treatments on the performance of broiler chickens is presented in Table 1. Broilers fed diets supplemented with Tetracin® at 0, 50, 100, 150 and 200mg per kg of feed recorded higher weight gain values of 99.7, 376.36, 375.13 and 330.1g respectively compared to those on control diet. As the inclusion level of the tetracycline increased so did the weight gained. The total feed intake (TFI) followed the same trend as total weight gain as it significantly (P<0.05) increased with the increase in the inclusion level of the feed additive although, no statistical difference was observed for T3, T4 and T5. The highest final body weight was in favour of both T3 (1997.00g) and T4 (2000.00g), which were significantly different (P<0.05) from the others. Birds on control treatment gave the lowest final body weight, body weight gain and total feed intake. The feed to gain ratio did not exhibit any significant changes (P>0.05) across the treatments.

Carcass characteristics, Cut-up parts and Organ weights

The main effect of Tetracin® inclusion levels on carcass characteristics (Table 2) showed a significant influence (P<0.05) on live weight, plucked weight, eviscerated weight (EW) and dressing percentage. There was a progressive increase with inclusion level of the feed-grade Tetracin® until 200mg/kg (T5) where a slight decline was observed but still better than the values obtained from the birds on the control diet. The presence of antibiotics however had no effect (P>0.05) on the bled weight of the

Table 1 :Growth performance of broiler chickens fed with graded levels of Tetracin®

Parameters (%)	T1 (0mg/kg)	T2 (50mg/kg)	T3 (100mg/kg)	T4 (150mg/kg)	T5 (200mg/kg)	SEM
IBW (g)	149.03	149.33	144.67	148.90	143.93	3.34
FBW (g)	1625.01^{d}	1725.00^{c}	1997.00^{a}	2000.00^{a}	1950.00^{b}	21.08
TBWG (g)	1475.98^{d}	1575.67^{c}	1852.33^{a}	1851.10^{a}	1806.07^{b}	23.09
TFI (g)	4534.15^{c}	4600.00^{b}	4626.67^{a}	4630.25^{a}	4638.84^{a}	34.65
FGR	3.07	2.92	2.49	2.50	2.57	0.25

^{abcd} Means with different superscripts on the same row are significantly different (P<0.05).

IBW - Initial body weight
FBW - Final body weight
TBWG- Total body weight gain
TFI - Total feed intake
FGR - Feed to gain ratio

broilers. The main effect of withdrawal period of Tetracin® on the carcass characteristics of the broiler chicken is presented in Table 2. The live weight and the dressing percentage significantly (P<0.05) reduced from 2050.31g in 0 day to 1924.13g in 15days and 70.36% to 68.38% in the dressing percentage as the withdrawal period increased from 0 day to 15 days. The interaction effect (Table 3) showed that bled weight was similar (P>0.05) within the treatments and also across withdrawal periods. Heaviest (P<0.05) values were recorded for T3 and T4 for live weight, plucked weight, eviscerated weight and dressing percentage across all the withdrawal periods and the values also reduced (P<0.05) as days of withdrawal period increased. Findings on the primal cut (Table 4) showed significant influence of Tetracin while withdrawal period did not have any appreciable influence (P>0.05) on the primal cuts (thigh, breast, drum stick, back, and wing). The interactive effect of inclusion level versus withdrawal period of Tetracin® on primal cuts of broiler chicken (Table 5) were significant (P<0.05) and similar to what was obtained from the main effects. T3 and T4 (100mg/kg and 150mg/kg respectively) at 0 day withdrawal period had the highest proportion of the cuts (thigh, breast, drumstick and back) except the wing. The values decreased as the withdrawal period increased. As indicated in Table 6, liver weight progressively increased with increase in level of Tetracin while no particular trend was observed in whole gizzard. The lungs, heart and kidney were not significantly (p>0.05) influenced by level of Tetracin. Only the liver was significantly (P<0.05) influenced by withdrawal period. At 0 day withdrawal period, the highest (2.40%) liver was observed compared to 7days (2.09%) and 15days (2.05) withdrawal period that were statistically similar (P>0.05). The lung, whole gizzard, heart and kidney weights were not significantly (P>0.05) affected. The interaction effect on the internal organs of broilers is presented on Table 7. Values were not significant (P>0.05) for heart, bile, spleen and the proventiculus,

Table 2: Effects of graded levels of Tetracin® on carcass characteristics of broiler chicken

Parameters (%)	Live weight (g)	Bled weight	Plucked weight	Eviscerated weight	Dressing %
Inclusion levels					
T1 (0mg/kg)	1625.00^{c}	94.68	84.83^{b}	72.01^{c}	62.09^{d}
T2 (50mg/kg)	1722.00^{b}	95.42	88.31^{a}	77.23^{b}	66.30^{c}
T3 (100mg/kg)	1995.61^{a}	95.45	89.33^{a}	83.23^{a}	73.09^{a}
T4 (150mg/kg)	1999.32^{a}	95.81	89.51^{a}	84.14^{a}	72.73^{a}
T5 (200mg/kg)	1941.10^{a}	95.44	88.14^{ab}	80.28^{ab}	70.11^{b}
	33.71	33.71	0.37	0.44	0.42
Withdrawal Periods					
0 day	2050.31^{a}	96.01	88.94	80.88	70.36^{a}
7 days	1993.04^{b}	95.84	88.77	79.87	68.38^{b}
15 days	1924.13^{c}	95.75	87.64	78.36	68.12^{b}
SEM	15.66	0.23	0.12	0.39	0.37

^{abc} Means with different superscripts on the same row are significantly different (P<0.05).

Table 3: Interaction effect of inclusion level and withdrawal period of Tetracin® on carcass characteristics of broiler chickens

Parameters (% live weight)		T1 (0mg/kg)	T2 (50mg/kg)	T3 (100mg/kg)	T4 (150mg/kg)	T5 (200mg/kg)	SEM
Live weight (g)							
	0	1625.00^{b}	1725.00^{ab,x}	1997.00^{a}	2000.00^{a}	1950.00^{a,x}	15.07
	7	1625.00^{a}	1721.00^{a,x}	1991.00^{a}	1997.00^{a}	1950.00^{a,x}	18.62
	15	1625.00^{d}	1701.00^{c,y}	1981.00^{a}	1990.00^{a}	1932.00^{b,y}	17.85
	SEM		20.23	19.22	19.45	19.98	
Bled weight							
	0	95.68	95.66	95.92	96.97	95.44	0.26
	7	95.68	95.70	95.77	95.80	95.33	0.43
	15	95.68	95.71	95.69	95.78	95.34	0.36
	SEM		0.49	0.52	0.41	0.39	
Plucked weight							
	0	84.83^{c}	89.11^{ab}	90.14^{a}	90.83^{a}	89.21^{ab}	0.42
	7	84.83^{b}	88.99^{a}	90.01^{a}	89.79^{a}	89.73^{a}	0.52
	15	84.83^{c}	88.75^{a}	88.91^{a}	87.91^{ab}	85.42$_{b}$	1.08
	SEM		0.72	0.62	0.45	0.56	
Eviscerated weight							
	0	72.01^{d}	78.44^{c}	85.21^{a}	85.31a	82.45^{b}	0.44
	7	72.01^{c}	76.91^{b}	83.62^{a}	83.81a	82.01^{a}	0.61
	15	72.01^{c}	75.01^{b}	82.74^{a}	82.11a	82.31^{a}	0.31
	SEM		0.67	0.56	0.74	0.76	
Dressing %							
	0	62.09^{c}	68.80b	73.09^{a}	70.61^{ab}	70.61^{ab}	0.44
	7	62.09^{d}	67.71c	71.21^{b}	70.24^{b}	70.24^{b}	0.49
	15	62.09^{d}	66.25c	72.30^{a}	71.30^{a}	68.35^{b}	0.34
	SEM		0.45	0.54	0.54	0.52	

^{abc} Means with different superscripts on the same row are significantly different (P<0.05).

$^{x, y, z}$ Means with different superscripts within the same column are significantly different (P<0.05)

Table 4: Effects of graded levels of Tetracin® on primal cuts of broiler chicken

Parameters (%)	Thigh	Breast	Drumstick	Back	Wing
Inclusion levels					
T1 (0mg/kg)	10.61^{c}	16.71b	11.18^{b}	13.89^{ab}	9.39^{b}
T2 (50mg/kg)	11.90^{b}	19.45^{a}	12.38^{a}	13.82^{ab}	9.50^{b}
T3 (100mg/kg)	12.82^{a}	20.82^{a}	12.66^{a}	14.72^{a}	10.30^{a}
T4 (150mg/kg)	12.86^{a}	20.89^{a}	12.78^{a}	14.56^{a}	10.49^{a}
T5 (200mg/kg)	12.32^{a}	19.92^{a}	11.61^{ab}	13.45^{b}	10.45^{a}
SEM	0.21	0.24	0.13	0.17	0.20
Withdrawal Periods					
0 day	12.31	19.78	12.26	14.08	10.10
7 days	12.15	19.43	12.29	14.12	10.03
15 days	11.95	19.32	11.47	13.83	9.62
SEM	0.11	0.07	0.14	1.12	0.16

Table 5: Interaction effect of inclusion levels and withdrawal period of Tetracin® on primal cut of broilers

Parameters (% live weight)		T1 (0mg/kg)	T2 (50mg/kg)	T3 (100mg/kg)	T4 (150mg/kg)	T5 (200mg/kg)	SEM
Thigh							
	0	11.61^{d}	$11.88^{c,y}$	$12.92^{a,x}$	$12.86^{a,x}$	$12.56^{b,x}$	0.13
	7	11.61^{c}	$12.21^{b,x}$	$12.57^{a,y}$	$12.59^{a,y}$	$12.27^{b,x}$	0.08
	15	11.61^{d}	$11.83^{c,z}$	$12.50^{a,z}$	$12.50^{a,z}$	$12.21^{b,y}$	0.19
	SEM		0.21	0.16	0.15	0.13	
Breast							
	0	16.71^{c}	$19.91^{b,x}$	$20.87^{a,x}$	$20.83^{a,x}$	$19.91^{b,x}$	0.29
	7	16.71^{c}	$19.44^{b,y}$	$20.63^{a,y}$	$20.60^{a,y}$	$19.32^{c,z}$	0.26
	15	16.71^{d}	$19.00^{c,z}$	$20.55^{a,z}$	$20.56^{a,z}$	$19.76^{b,y}$	0.23
	SEM		0.20	0.26	0.18	0.21	
Drum stick							
	0	11.18^{d}	$11.90^{c,z}$	$12.43^{b,x}$	$12.57^{a,x}$	12.45^{b}	0.12
	7	11.18^{c}	$12.44^{a,x}$	$12.32^{b,y}$	$12.47^{a,y}$	12.41^{a}	0.15
	15	11.18^{c}	12.10^{ay}	12.35^{by}	12.10^{a}	10.08^{d}	0.14
	SEM		0.23	0.17	0.15	0.23	
Back							
	0	13.89^{a}	13.37^{d}	14.48^{a}	14.10^{b}	14.08^{b}	0.96
	7	13.89^{d}	13.56^{e}	14.47^{b}	14.97^{a}	14.07^{c}	0.83
	15	13.89^{c}	14.22^{a}	14.58^{e}	14.08^{b}	11.85^{d}	0.23
	SEM		0.42	0.41	0.36	0.31	
Wing							
	0	9.39^{c}	9.85^{a}	10.37^{c}	10.77^{b}	9.92^{d}	0.10
	7	9.39^{b}	9.35^{b}	10.62^{a}	10.35^{b}	10.67^{a}	0.14
	15	9.39^{b}	9.45^{a}	9.67^{d}	10.21^{c}	10.42^{d}	0.20
	SEM		0.26	0.19	0.20	0.21	

^{abcd} Means with different superscripts on the same row are significantly different (P<0.05).
^{x,y,z} Means with different superscripts within the same column are significantly different (P<0.05)

Table 6: Effects of graded levels of Tetracin® on organ characteristics of broiler chicken

Parameters (%)	Liver	Lung	Gizzard	Heart	Kidney	Spleen
Inclusion levels						
T1 (0mg/kg)	1.87^{c}	0.66	4.38^{a}	0.53	0.67	0.12
T2 (50mg/kg)	2.08^{b}	0.63	4.10^{c}	0.49	0.58	0.19
T3 (100mg/kg)	2.17^{b}	0.59	4.21^{b}	0.49	0.55	0.16
T4 (150mg/kg)	2.21^{b}	0.56	3.56^{d}	0.50	0.53	0.15
T5 (200mg/kg)	2.43^{a}	0.68	4.10^{c}	0.48	0.62	0.19
SEM	0.14	0.07	0.61	0.12	0.31	0.07
Withdrawal Periods						
0 day	2.40^{a}	0.70	4.19	0.58	0.57	0.15
7 days	2.09^{b}	0.62	4.21	0.54	0.54	0.16
15 days	2.05^{b}	0.60	4.22	0.62	0.60	0.14
SEM	0.39	0.34	0.34	0.24	0.07	0.06

Table 7: Interaction effect of inclusion levels and withdrawal period of Tetracin® on internal organs characteristics of broiler chickens.

Parameters (% live weight)		T1 (0mg/kg)	T2 (50mg/kg)	T3 (100mg/kg)	T4 (150mg/kg)	T5 (200mg/kg)	SEM
Liver							
	0	1.87^{c}	1.91^{c}	$2.50^{b,x}$	$2.47^{b,x}$	$2.61^{a,x}$	0.41
	7	1.87^{c}	2.05^{b}	$1.81^{c,y}$	$1.87^{c,y}$	$2.31^{a,y}$	0.04
	15	1.87^{c}	2.06^{b}	$1.90^{b,y}$	$1.77^{c,y}$	$2.20^{a,z}$	0.04
	SEM		0.23	0.27	0.30	0.31	
Lung							
	0	0.66^{c}	$0.72^{b,x}$	0.55^{d}	$0.82^{a,x}$	$0.65^{c,y}$	0.68
	7	0.66^{b}	$0.62^{bc,y}$	0.59^{c}	$0.43^{d,y}$	$0.73^{a,x}$	0.15
	15	0.66^{a}	$0.62^{b,y}$	0.56^{c}	$0.51^{d,y}$	$0.57^{c,z}$	0.14
	SEM		0.21	0.32	0.24	0.27	
Whole gizzard							
	0	4.38^{a}	$3.85^{bc,y}$	$3.55^{c,y}$	$3.61^{c,x}$	$4.15^{b,x}$	0.45
	7	4.38^{ab}	$4.57^{a,x}$	$4.59^{a,x}$	$3.14^{c,x}$	$4.28^{b,x}$	0.09
	15	4.38^{a}	$3.93^{ab,y}$	$4.21^{a,x}$	$3.77^{b,y}$	$3.77^{b,y}$	0.70
	SEM		0.34	0.23	0.22	0.25	
Heart							
	0	0.53	0.50	0.46	0.59	0.48	0.01
	7	0.53	0.52	0.44	0.41	0.52	0.02
	15	0.53	0.40	0.57	0.45	0.39	0.01
	SEM		0.07	0.07	0.11	0.06	
Kidney							
	0	0.67	0.56^{xy}	0.49^{y}	0.53	0.62	0.02
	7	0.67^{a}	$0.47^{b,y}$	$0.41^{c,y}$	0.43^{c}	0.57^{ab}	0.02
	15	0.67^{a}	$0.66^{a,x}$	$0.70^{a,x}$	0.54^{b}	0.67^{a}	0.02
	SEM		0.08	0.04	0.06	0.07	
Spleen							
	0	0.12	0.10	0.17	0.14	0.15	0.01
	7	0.12	0.27	0.10	0.11	0.11	0.01
	15	0.12	0.18	0.09	0.09	0.12	0.01
	SEM		0.03	0.02	0.05	0.03	

^{abcd} Means with different superscripts on the same row are significantly different (P<0.05).
^{x,y,z} Means with different superscripts within the same column are significantly different (P<0.05)

while it was significant (P<0.05) for liver, lung, whole gizzard and kidney both within and among the treatments. Variation existed between the groups fed with the antibiotics and the control. Along inclusion level of the antibiotic and across its withdrawal periods, significant differences (P<0.05) were seen in the lung and whole gizzard.

Antibiotics residues

There was no antibiotic residue found in the breast muscle of the chicken irrespective of the inclusion level and periods of withdrawal (Table 8). The thigh muscles were however not spared as antibiotic residue was shown to occur at 0 day withdrawal period. By virtue of the importance of the internal organs; liver and kidney, which are directly involved in the digestion, absorption and utilization of nutrients, the residues were present in both organs at 0 day withdrawal period at 100mg/kg up to 200mg/kg. At 150mg/kg and 200mg/kg (7 days withdrawal period) the residue was present in the liver while it was only present in kidney at 200mg/kg of the same withdrawal period. Out of all the 104 samples (meat and organs), 25% were found to be positive for antibiotic residue. The thigh muscle recorded 5.77% residue while the remaining was found for liver and kidney with 11.54% and 7.69% respectively.

Table 8: The occurrence of antibiotic residues in muscle and organs of broilers fed with graded levels of Tetracin®

Parameters		T1(0mg/kg)	T2(50mg/kg)	T3(100mg/kg)	T4(150mg/kg)	T5(200mg/kg)
Thigh	0	-ve	-ve	+ve	+ve	+ve
	7		-ve	-ve	-ve	-ve
	15		-ve	-ve	-ve	-ve
Breast	0	-ve	-ve	-ve	-ve	-ve
	7		-ve	-ve	-ve	-ve
	15		-ve	-ve	-ve	-ve
Liver	0	-ve	-ve	+ve	+ve	+ve
	7		-ve	-ve	+ve	+ve
	15		-ve	-ve	-ve	+ve
Kidney	0	-ve	-ve	+ve	+ve	+ve
	7		-ve	-ve	-ve	+ve
	15		-ve	-ve	-ve	-ve

Discussion

The improvement in weight gain and feed efficiency consequent upon antibiotic supplementation to the basal diet reinforced the findings of (14, 15 16, 17 and 18) that feed additives enhanced nutritional values and utilization of feed. The improvement in feed conversion efficiency and better growth rate observed in this study allowed production of cheaper meat and possibly healthier animals. The magnitude of growth promotion by the inclusion of the feed additive even at T2 (50 gm/kg) showed that broilers are capable of responding to slight changes in their diet, which is consistent with the findings of (14) and (15) on the potentials of non-nutritive feed additives in livestock feeds. It is suggested that antimicrobial substances have a growth promoting effect through their actions on the enteric bacteria by one or more of the following mechanisms; inhibition of sub-clinical infections from pathogenic microorganisms, reduction in growth depressing microbial metabolites, reduced competition for nutrients by gastrointestinal microorganisms, alteration of metabolic activity and enhanced uptake and utilization of nutrients via the thinner intestinal wall associated with antibiotic-fed animals (4, 18, 19). The significant benefits of antibiotic supplementation observed on chick growth and feed conversion in the present study, were similar to those reported widely in the reviews of (20) and (21).

The variations ($P<0.05$) seen in the parameters for the carcass was in line with the report of Ikeme (22) who stated that higher pre-slaughtered weights are expected to produce higher carcass weight. It was only in the bled weight that no significant influence of the feed grade antibiotic was noticed as other parameters (plucked weight, eviscerated weight and dressing percentage) increased with the inclusion levels of the antibiotic. This is in line with the report of (14) who recorded better eviscerated weight and carcass yield with antibiotics supplemented diets high in fiber compared with the control. This has further shown that carcass may change appreciably with the addition of feed grade antibiotics that are employed to enhance feed nutritional values. Ikeme (22) and Akinwumi (23) had earlier reported that bled weight, plucked weight and dressed weight followed the same trend with the pre-slaughtered weight but no reason could be deduced to the non significant values reported for the bled weight as reported in this study. The dressing percentage values are similar to the findings of Toghyani *et al.* (24) who obtained 73% when prebiotic, antibiotic and probiotics were added to broiler feed but lower than that of Bolu *et al.* (25) that reported 91.20% with Alphamune as growth promoter in turkey poults. Higher dressing percentage will ensure higher returns especially in Nigerian market. The sale of chicken parts is now the vogue rather than as whole carcass in Nigeria. Inclusion of the feed grade antibiotic enhanced weight of primal cuts as observed by (25), (26) and (27).

The weight of organs has been reported by (18, 28) to reflect the anatomical response of birds to the type of diets consumed. Hepatic weights of broilers supplemented with feed grade antibiotic were heavier than the control and progressively increased with the increase in the inclusion level of the antibiotics. Onifade (14) stated that higher hepatic weight could be as a result of hypertrophic response. However, the expression of large liver with the antibiotic supplemented birds is an indication of the damaging effect of antibiotics since the organ is involved in processing or excretion of waste, metabolites and toxic substances (29). Moreover, the values improved when withdrawal period was observed. Reduced gizzard weight was also reported for the antibiotic supplemented birds and this was in line with the findings of (14) that antibiotics-moderate gizzard hyperplasia, and by extension the conservation of dietary metabolizable energy for growth. The reduction in lung weight was an indication that lung capacity did not always meet the oxygen demand necessary for rapid growth (25) while (31) stated that if the lung of the chicken grows less rapidly than the rest of the body, hypoxia and ascites could result.

The present study showed that some of the samples (thigh, liver and kidney) had detectable levels of Tetracin® residue at the time of slaughter with the exception of breast muscles. Tetracin® was distributed widely in the body tissue and excretory organs like liver and kidney. This observation was similar to that of (5, 32, 33, 34, 35) for different animals and antimicrobials but differ from that of (36) and (37) who observed higher concentration in kidney than the liver. Liver and kidneys are excretory organs concerned with the elimination of drugs hence the presence of residues. Shareef *et al.,* (38) had earlier reported that liver and breast had the highest percentage (56%) each of antibiotic detection, followed by thigh muscle (44%) on poultry products in Iran. De Vos *et al. (39)* evaluated polychlorinated biphenyl residues in poultry and reported higher concentrations in thigh than breast tissues. These authors suggested that the higher concentrations detected in thigh tissue is due to the lipophilic nature of polychlorinated biphenyls and the greater intra- muscular fat content of thighs determined during that study (fat in thigh tissue ranged from 3.1 to 11.9%

and in breast from 0.8 to 1.5%).

Even though the present study found residues in thigh muscle while none was found in the breast, the possibility also exists that other edible muscle tissues (e.g., shank or wings) could have even higher levels. Reyes- Herrera *et al.* (40) concluded that the site of preferential residue deposition could vary between different antibiotics. In other words, fluoroquinolone residue concentrations were higher in breast versus thigh tissues. Reyes- Herrera *et al.* (40) reported that another antibiotic might produce higher concentration of residue in thigh muscle. Moreover, the inclusion of antibiotics has been reported (41) to improve the chemical properties of broiler meat while the physical and sensory properties were compromised. Observing withdrawal period for 15 days was reported to improve physico-chemical properties without any adverse effect on the general acceptability of broiler chicken (42).

Conclusion and Application

This study revealed that;

1. Inclusion of Tetracin® at 100 - 150 mg/kg improved feed intake, weight gain, carcass and primal cut weights of broiler.
2. Adhering to labeled dosage and withdrawal period is not detrimental to the weight of carcass and primal cut of broiler chicken
3. Tetracin® residue was found in the thigh muscle and organs at 100 - 2000 mg/kg only when withdrawal periods were not observed but also present in the kidney and liver even at 7 and 15 days withdrawal period respectively.

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