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Effect of finisher diets of different crude protein levels on carcass yield and abdominal fat pads of roaster chickens raised on tri-phase feeding regime

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Target Audience: *Broiler farmers, broiler meat processors and consumers.*

Abstract

Excessive fat deposition in poultry carcass can reduce carcass and processing yields especially in broiler chickens, hence the need to reduce it through dietary manipulations. One hundred and twenty finisher broilers were used to investigate the effect of different crude protein levels on carcass yield and abdominal fat pads of roasters raised on tri-phase feeding regime. The feeding trial comprised of a starter phase (0-4 weeks), a grower phase (4-8 weeks) and a finisher phase (8-12 weeks) on broiler finisher diets of varying crude protein levels. Treatment (T1) (control) had no restriction but fed commercial finisher diet from 4-12 weeks after brooding. T 2 (four weeks growth restriction on grower diet after brooding and finishing to 12 weeks on 18% crude protein. T3 (four weeks growth restriction on grower diet after brooding and finishing to 12 weeks on 19% crude protein . T4 (four weeks growth restriction on grower diet after brooding and finishing to 12 weeks on 20% crude protein . Two birds per replicate were slaughtered at twelve weeks of age to evaluate the carcass and internal organs. Restricted groups on 18% CP had significantly higher carcass yield. Abdominal fat was significantly higher in the control. Carcass yield of growth-restricted roasters was influenced by crude protein levels of the finisher diets while abdominal fat was reduced by both restriction to retard growth and the high fiber content of the grower and finisher diets. 19 and 20% crude protein levels in finisher diets with high fibre content produced low carcass weight in nutrient/growth restricted broilers.

Key words: *Roasters, carcass yield, abdominal fat, crude protein, phase feeding.*

Description of Problem

Roasters are broiler chickens of three to five months of age which are raised to heavier weights of more than 2.8kg, up to 3 – 4kg(7). Poultry carcass has been used as one of the criteria for defining poultry meat quality. Poultry meat with maximal meat yield and low fat content has been described as good quality poultry meat (1). According to (1), excessive fat deposition in poultry carcass is an undesirable trait to producers and processors as it reduces carcass yield, processing yields and value of commercial cuts. It also reduces consumer acceptance of poultry meat because it could lead to obesity and heart related diseases (2).

Unfortunately, the divergent selection programmes for fast growth in the modern broiler chicken has led to production of commercial broiler strains with excessive fat deposition. This has stimulated several researches on poultry carcass quality particularly in reduction of carcass fat content (mainly abdominal fat) and increasing the lean tissue yield. (3) had reviewed series of feeding strategies aimed at reducing fat deposition in modern poultry strains. These include: Nutrient levels on abdominal fat, fat types on abdominal fat, conjugated linoleic acid on abdominal fat, various feed additives on abdominal fat and feed restriction on abdominal fat (3).

There is a current trend in the United States of America to increase the marketing age of broiler chicken in order to meet the changing needs of processors and for the industry to compete in world market (4). According to (4), the market age of broilers in the United States of America is approaching 56 – 60 days for male broilers with a marketing age of up to 80 days being suggested when future directions of the industry were discussed. Increasing the market age of the broiler using conventional feeding system will lead to increase in carcass fatness and problems of metabolic disorders (4). There is therefore need for a production system that would increase the growing period of the broiler without the associated problems of carcass fatness and metabolic disorders. A high- low- high tri-phase feeding system using finisher diets of varying crude protein levels has potentials for this. Tri-phase feeding system can be used to delay maturity and increase the growing period of the broiler. This will give the broilers opportunity for compensatory growth and more time to refashion their growth curve when normal nutrition is restored following periods of under nutrition. The crude protein levels will be used to manipulate the carcass fat (mainly abdominal fat). (5) reported that, increasing dietary crude protein level from 17% to 23% in broiler chickens from 21 to 63 days of age caused a significant reduction in abdominal fat deposition. Abdominal fat is described as a reliable parameter for judging total body fat content in broilers because it is directly linked to total body fat content in avian species (6).

This research was designed to raise Roaster chickens of twelve weeks of age using a high-low-high phase – feeding system. The objective was to determine the effect of finisher diets of different crude protein levels on carcass yield and abdominal fat pads of the chickens.

Materials and Methods

Experimental site

This research was carried out at the Poultry Unit of the Teaching and Research Farm of Cross River University of Technology, Faculty of Agriculture, Obubra Campus, Cross River State, Nigeria. Obubra is located along Latitude 6” 4.6032’ N and Longitude 8” 19.9446’ East (8).

Feeding Trials

The experiment comprised a high- low- high- phase feeding which included:

1. Starter phase on commercial broiler starter ration (0 - 4 weeks)
2. Grower phase on grower ration (4 – 8 weeks)
3. Finisher phase on broiler finisher rations of varying crude protein levels which represented the treatments as described in Table 1 (8 – 12 weeks) following nutrient restriction with grower ration.

Experimental Treatments and Design

The experiment comprised four treatments, each was replicated three times in a complete randomized design.

The treatments included:

T_1 Control, no restriction – fed commercial finisher ration from 4 – 12 weeks after brooding with commercial starter ration.

T_2 Four weeks restriction using Grower ration from 4 – 8 weeks and 18% CP finisher ration from 8 – 12 weeks.

T_3 Four weeks restriction – Grower ration from 4 – 8 weeks and 19% CP finisher ration from 8 – 12 weeks.

T_4 Four weeks restriction– Grower ration from 4 – 8 weeks and 20% CP finisher ration from 8 – 12 weeks.

Experimental Diets

The experimental diets and their proximate compositions is presented in Table 1.

Table1: Gross Composition of Experimental Finisher Diets

Ingredients (%)	T_1(Control)*	T_2 18% CP	T_3 19% CP	T_4 20% CP
Maize	-	33.00	30.20	27.55
Ground cake	-	10.95	13.70	16.40
Fish meal	-	2.00	2.00	2.00
Palm kernel cake (PKC)	-	50.00	50.00	50.00
Bone meal	-	3.00	3.00	3.00
Salt	-	0.25	0.25	0.25
Lysine	-	0.20	0.20	0.20
Methionine	-	0.10	0.10	0.10
Min/Vit. Premix**	-	0.50	0,50	0.50
Cost/kg of feed (₦)	76.0	41.00	41.00	41.00
Calculated chemical composition (% of DM)				
Crude protein %	20.00	18.00	19.00	20.00
Fat (%)	3.00	4.32	4.38	4.46
Crude fibre (%)	5.00	7.24	7.34	7.41
Calcium (%)	1.00	0.90	0.91	0.91
Phosphorus (%)	0.70	0.46	0.47	0.47
Lysine (%)	-	0.66	0.70	0.73
Methionine (%)	-	0.33	0.34	0.35
ME (Mcal/kg)	2.98	2.38	2.35	2.33
Energy/protein ratio	149/1	132/1	123.7/1	116/1

*Commercial finisher ration (Top Feed®)

*** Each 2.5kg of premix contained: Vitamin A, 8,000,000 iu; Vitamin $D_{1,}$ 600,000 iu; VitaminE, 20,000 iu; Vitamin K, 2,000mg; Vitamin $B_{1,}$ 1,5000mg; Vitamin $B_{2,}$ 4,000mg; Vitamin $B_{6,}$ 2,000mg; Vit. $B_{12,}$ 10mg; Niacin, 15,000mg; Panthotenic Acid, 5,000mg; Folic Acid, 500mg; Biotin, 20mg; Choline Chloride, 200,000mg Manganese, 80,000mg; Zinc, 50,000mg Iron, 20,000mg; Copper, 5,000mg; Iodine, 1,000mg; Selenium, 200mg; Cobalt, 500mg; Antioxidant, 120,000mg.*

Management of experimental birds

Starter phase

One hundred and thirty (130) day –old broiler chicks (Ross 308) were purchased from a commercial distributor in Calabar. The birds were brooded in deep litter pen measuring 3 x 5m^2 using standard husbandry practices for brooding broilers. Feed and water were given *ad-libitum*. They were fed on commercial starter ration (Top feed$^{(R)}$). All necessary vaccinations were administered. Other medications including coccidiostats were given when symptoms were observed. The brooder phase lasted four weeks (day -1 to week four).

Grower phase

At the end of the brooding phase, one hundred and twenty (120**)** birds were randomly selected and divided into four treatment groups of three replicates consisting of ten birds each and was randomly assigned as T_1 (control), T_2, T_3 and T_4. Grower ration was fed to the three experimental groups (T_2, T_3 and T_4) to induce growth retardation, while the control (T_1) was fed commercial finisher ration (Top feed$^{(R)}$. The grower phase lasted four weeks (5 – 8 weeks).

Finisher phase

At the end of the eight weeks, three finisher rations of varying crude protein levels (18, 19and 20% crude protein – Table 1) were introduced to $T_{2,}$ T_3 and T_4 respectively. These were fed to the birds for the remaining four weeks (8 – 12 weeks).

Data collection

The birds were weighed at the start of the experiment to get their initial body weights. They were subsequently weighed on weekly basis for weekly body weights. Feeds offered daily were weighed and the left-over were weighed the following morning to get the feed intake.

At the end of the experiment at 12 weeks of age, two birds per replicate were selected to evaluate the carcass and internal organs. The birds were fasted for 12 hours but were given water. They were weighed before slaughtering to get their pre-slaughter weights. The slaughtering and dressing were carried out using standard procedures for processing broilers.

Data analysis

The data obtained were subjected to analysis of variance using statistical package for social sciences (SPSS) version 16.0 (student's version). Significant means ($P<0.05$) were separated using Duncan's Multiple Range Test of the same software.

Results and Discussion

The pre-slaughter weights, dressed weights, carcass yield and internal organ weights of broiler chickens fed finisher diets of different crude protein levels after periods of under nutrition are presented in Table 2.

Results

Pre-slaughter weights and carcass yield of the experimental birds.

The T2 birds (restricted group on 18% CP re-feeding) had significant ($P<0.05$) lower pre-slaughter weight but were significantly ($p<0.05$) higher in carcass yield in comparison with all the other groups including the control. The restricted groups on 19 and 20% crude protein re-feeding (T3 and T4 respectively) were significantly ($p<0.05$) lower in carcass yield in comparison with the T2 group despite their significantly higher pre-slaughter weights. The control was significantly ($P<0.05$) higher in pre-slaughter weight and dressed weights than all the restricted group but did not differ ($P>0.05$) in carcass yield with 19 and 20% CP re-feeding but significantly ($P<0.05$) lower than the group on 18% CP re-feeding.

Abdominal fat of the experimental birds

Abdominal fat was significantly ($P<0.05$) higher in the control birds than in the restricted groups irrespective of the crude protein levels.

Discussion

The low dressed weight and low carcass yield of T3 (19% CP) and T4 (20%CP) groups in relation to their pre-slaughter weights could be due to the low energy content of their diets in relation to protein levels (energy: protein ratio) (Table 1), thereby making excess nitrogen available. This result is supported by the age-long report of (9) that non-ruminants given extravagant nitrogen following low or restricted intakes showed evidence of compensatory growth in non-carcass components of the body. According to (9) the phenomenon of compensatory growth is associated with replenishment of labile nitrogen stores in the skin, in the viscera and in the blood, thus resulting in low dressed weight in relation to high pre-slaughter weight.

The significantly higher ($P<0.05$) abdominal fat pads of the control birds in comparison with the restricted group could be due to the high density finisher diets of the control birds. This is supported by the report of (4) that conventional feeding of broilers on high density diets (high energy/high protein) leads to increase in carcass fatness. This resulted in low carcass yield in comparison with T2 group, despite the significantly higher pre-slaughter weight (3.81kg).This is supported by the report of (1) that excessive fat deposition in poultry carcass reduces carcass yield.

The low abdominal fat content of the growth restricted groups could be due to the high dietary fibre and the under nutrition employed to retard growth This is supported by the report of (10) that high dietary fibre in poultry diets reduces adiposity by reducing the metabolizable energy content of the diets. This is also supported by the report of (11) that feed restriction either by quantitative or qualitative means reduced fat deposition by inhibiting the activities of the lipogenic enzymes in the liver of the broiler chicken.

Table 2: Carcass characteristic and relative organ weights of broiler chickens fed finisher diets of different crude protein levels following growth restriction with grower diets

Parameters	T_1 (Control)*	T_2 18% CP	T_3 19% CP	T_4 20% CP	SEM
Initial body weight (kg)	0.92	0.92	0.93	0.92	-
Final body weight (kg)	3.84	2.77	3.23	3.22	0.25
Pre-slaughter weight (kg).	3.81^a	2.72^c	3.21^b	3.13^b	0.20
Dressed weight. (kg)	2.69^a	2.25^b	2.31^b	2.24^b	0.42
Carcass yield (%)	75.85^b	82.72^a	72.00^b	71.56^b	4.8
Internal organs (% of pre-slaughter weights)					
Heart	0.41	0.44	0.44	0.44	0.11ns
Liver	1.50	1.60	1.6	1.50	9.15ns
Gizzard	1.20^b	2.20^a	2.50^a	2.50^a	0.5
Abdominal fat	3.00^a	1.80^b	1.70^b	1.70^b	0.97

^{ab}Means with different superscript within the same row are significantly different (P<0.05).
ns = not significant

Conclusion and Applications

1. T2 (growth restricted birds on 18% CP diet) had the highest carcass yield in comparison with all the other groups including the control.
2. T3 and T4 (growth restricted birds on 19 and 20% CP diets respectively) had low dressed weights and low carcass yield despite their higher pre-slaughter weights.
3. Abdominal fat was significantly higher in the control birds than in the growth restricted birds irrespective of the crude protein levels of the diets.
4. Carcass yield of growth /nutrient restricted birds as well as the abdominal fat were influenced by dietary treatments.
5. 19 and 20% crude protein levels in finisher diets with high fibre content produced low carcass weight in nutrient/growth restricted broilers.
6. The quality of the dietary protein in the finisher diets of nutrient/growth restricted broilers should be improved by reducing the high content of fibre (such as PKC used in this research) and increase the levels of lysine and methionine which were below standard levels (Table 1), to improve protein utilization by the growth retarded birds and avoid nitrogen excretion.

References

1. Fletcher D.L. (2002). Poultry Meat Quality. *World's Poultry Science Journal,* 58(2):131-145. Doi: 10.1079/wpsj 20020013.
2. Wahrburg U. (2004), what are the health effects of fat? (PubMed). *European Journal of Nutrition,* 43(1):6-11. Doi: 10.1007/8004-1103-9.
3. Fouad A.M and EL-Senousey .H.K (2014). Nutritional Factors Affecting Abdominal Fat Deposition in Poultry: A review. *Asian –Australian Journal of Animal Science*, 27(7):1057-1068.
4. Leeson S. (2017).Feeding Programmes for heavy Broiler chickens –Engormix https://en.engormix.com>feeding program-heavy-broiler-33308-htm.
5. JLali M., Giguad V., Metayer-Coustard S., Sellier N., Tesseraud S., Lc Bihan-Duva E and Beri C. (2012). Effect of Crude protein levels in 2 chicken genotypes.

Journal of Animal Science, 90: 445 – 455.

6. Tumova A and Teimouri A (2010). Fat deposition in broiler chickens: A review. *Scientia Agriculturae Bochemica*, 41(2): 21 – 28.
7. National Chicken Council (2018). Chicken Labelling terms. Natl.ChickenCouncil @ chickencouncil.washingtonDC.nationalchi ckencoucil.org
8. Date and Time information (2020). Geographical c00rdinates of Obubra in degrees and Minutes. Link: https://dateandtime info/citycoordinates.php?id=2328153
9. Tullis J.B., Wiltmore C.T. and Philips P. (1986). Nitrogen retention in pigs given extravagant nitrogen intakes following low intakes. *British Journal of Nutrition*. 36:257-267.
10. Hocking P.M, Zachek V., Jones E.K.M and Macleod M.G. (2004). Different concentrations and sources of dietary fibre may improve the welfare of female broiler breeders. *British Poultry Science*, 45: 9 - 19.
11. Yang X, Zhuang J., Rao K., Zhao. R (2010). Effect of early feed restriction on hepatic lipid metabolism and expression of lipogenic genes in broiler chickens. *Research in Veterinary Science*, 89:438-444. (PubMed)(Google Scholar).