

DIETARY SUPPLEMENTATION OF SILICON OXIDE ON CARCASS CHARACTERISTICS AND LITTER QUALITY OF BROILER CHICKENS

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ABSTRACT

This experiment was conducted to evaluate the effects of different levels of silicon oxide on carcass characteristics and litter quality of broiler chickens. In total, 120 mixed sex Abor Acre broiler chicks were distributed according to a completely randomized design. The control group was fed a diet without silicon oxide, while treatments 2-4 were fed diets supplemented with 10, 20 and 30g/100kg silicon oxide respectively. At the end of the starter (0-3 weeks) and finisher (4-7 weeks) phases, litter samples were collected at random from different locations from all the replicates and scored for litter quality test. Also at the end of the finisher phase three birds per replicate were selected on the basis of weights for carcass characteristic study. Silicon oxide supplementation improved broiler carcass characteristics, as shown by higher breast, back, thigh, drumstick, shank, and gizzard weights. Chickens fed silicon oxide supplemented diets had significantly ($p < 0.05$) better carcass characteristics compared with those chickens fed diet without silicon oxide. Litter quality and abdominal fat were not influenced by the treatments. It was concluded that carcass characteristics of broiler chickens were better in birds fed 20g silicon oxide /100kg diet compared to chickens fed without silicon oxide.

Keywords: silicon oxide, carcass, broiler, litter, tropics

INTRODUCTION

One of the most important recent challenges in broiler production has been associated to skeletal disorders, particularly those affecting the legs (Manohar *et al.*, 2015). This can be caused by intensive genetic selection, an increase in the nutritional quality of feed and the increased demand for poultry as a food source, leading to a drive for faster production rates (Bradshaw *et al.*, 2002). Unfortunately, selection for large pectoral mass did not occur alongside selection for a stronger musculoskeletal support system, with an investigation by Robinson *et al.* (2007) revealing that high breast-yielding strains had reduced carcass frames. Silicon (Si) has been linked to the calcification of growing bone and deficiency in poultry diets has been shown to lead to a number of health and welfare issues, such as various skeletal weaknesses. Safaeikatoouli *et al.* (2012) and Tauqir *et al.* (2001) reported that poultry performance was improved with the use of silicate minerals in broiler diets. However, in turkeys, body weight gain and feed conversion ratio (FCR) significantly improved with dietary Si dioxide supplementation (Tran *et al.* 2015). In addition, silica increase dissolved oxygen in water and therefore helps reduce ammonia in litter and manure (Scholey *et al.*, 2018). There has been a gap in the revisions made in the Nutrient requirement of poultry (NRP) since 1994, the majority have focussed on macronutrient provision, with some updates to the provision of essential vitamins and minerals, but no changes (or additions) have been made to reflect the growing body of work surrounding trace and ultra trace elements like silicon oxide despite its importance in regard to bone mineralisation. Therefore, this experiment was conducted to review the effect of silicon oxide on carcass characteristic and litter quality of broiler chickens reared under tropical environment.

MATERIAL AND METHODS

Experimental site

The experiment was conducted at the Poultry Unit of livestock section Kabba College of Agriculture, Teaching and Research farm, Ahmadu Bello University. The study area is located within the Southern Guinea Savannah agro-ecological zone and the coordinate of the study area is Latitude 07° 51.128' N and Longitude 006° 04.273' E.

Experimental design, diets and management of birds

One hundred and twenty (120) one-day old Abor Acre broiler chickens of mixed sexes were assigned to four dietary treatment groups were distributed on the basis of equal weight into three replicates per treatment with 10 birds each in a completely randomized design. The birds were housed in deep litter pens and all necessary routine management practices were observed. Broiler starter and finisher diets were fed from 0 – 3 weeks and day 4-7 weeks, respectively. Water and feed were administered *ad libitum* for the 7 weeks' experimental period. The necessary medications and vaccinations were administered as at when due. The diets were isocaloric and isonitrogenous and formulated to meet the nutrient requirements of the broiler chicks during starter and finisher periods (Table 1) according to the National Research Council requirements (1994). A basal diet was formulated such that treatment 1 was without silicon oxide (control), treatment 2-4 had 10g, 20g and 30g silicon oxide/100kg diet respectively.

Table 1: Diets composition

Ingredients	Basal diet (starter)	Basal diet (finisher)
Maize	52.80	60.50
Soyabean cake	28.00	22.00
GNC	13.74	12.14
Palm oil	1.20	1.30
Bone meal	2.80	2.70
Limestone	0.50	0.50
Common Salt	0.30	0.30
Methionine	0.18	0.15
Lysine	0.18	0.16
Vit-min-Premix ¹	0.30	0.25
Total	100.00	100.00
Calculated Nutrient		
ME (Kcal/kg)	3010	2998
Crude Protein (%)	23.10	20.00
Crude Fibre (%)	3.73	3.73
Ether Extract (%)	5.84	5.84
Calcium (%)	1.27	1.27
Phosphorus (%)	0.83	0.83
Methionine (%)	0.86	0.86
Lysine (%)	1.28	1.28

¹Vitamin mineral premix provide per kg of diet. Vit. A, 13,340 i.u; Vit. D₃, 2680 i.u; Vit. E, 10 i.u; Vit. K, 2.68 mg; Calcium pantothenate, 10.68mg; Vit. B₁₂, 0.022mg, Folic acid, 0.668mg; Choline choride, 400mg; Chlorotetracycline, 26.68mg; manganese, 13mg; iron, 66.68mg; Zinc, 53.34mg; Copper, 3.2mg; Iodine, 1.86mg; Cobalt, 0.268mg; Selenium, 0.108mg

Carcass characteristics

At the end of the 7th week of the feeding trial, three birds from each pen with approximate body weights equal to the mean weight of the birds in the pen were used. They birds were fasted overnight in order to allow for the emptying of the gastro-intestinal tract (GIT) and weighed. The selected birds were slaughtered for carcass analysis by severing the neck with a sharp knife and allowed to bleed completely. They were then defeathered and eviscerated. The liver and gizzard, and the thigh and breast were weighed and expressed as percentages of the live body weight and the carcass weight respectively. The intestinal length was measured in centimeters. The dressed weights were taken and the dressing percentages computed.

$$\text{Dressing percentage} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

Litter quality

At the end of the experimental period litter samples were visually scored on a scale of 1 to 5 (1 driest to 5 wettest) adapted from Hooge *et al.* (2012) with some modifications, as follows:

1. Dry, friable material throughout the pen.
2. Predominantly dry material and mostly acceptable but with some areas of wet shavings.
3. Poor quality litter material with a large proportion of wet areas.

4. Unacceptable litter quality, wet but with a few areas of dry material remaining.
5. All litter wet and soggy, no dry areas left.

Data analysis

All data obtained from the two experiments were subjected to analysis of variance (ANOVA) using the General Linear Model Procedures (GLM) of the Statistical Analysis Software package. Significant difference between treatments means were separated using Duncan Multiple Range Test (SAS, 2002).

RESULTS AND DISCUSSION

The effect of varying level of silicon oxide supplemented diet on carcass characteristics of broiler chickens were as shown in Table 2. Dietary treatments had significant ($P < 0.05$) effects on live weight (LW), carcass weight (CW), dressing percentage (DP), back, gizzard, breast, wings, thigh, drumstick and abdominal fat. It was observed that chickens fed diet supplemented with 20g/100kg silicon oxide had the best results in terms of LW, CW, and DP as compared to other treatments. Chickens fed 20g silicon oxide /100kg diet had the best results in terms of back, breast, gizzard, wing, thigh and drumstick. However, chickens fed 30g silicon oxide /100kg diet had the best result in terms of gizzard and spleen weights. Generally, it was observed that majority of the carcass parameters measured were higher for chickens fed silicon oxide compared to fed chickens without silicon oxide. This result disagrees with the findings of Aksu *et al.*, (2010b) who reported that basal diets containing lower levels of trace minerals were similar in carcass weight than birds fed diets without trace minerals. Also, Ara'ujo *et al.* (2019) reported no significant difference in weight gain/carcass weight of birds diets supplemented with organic trace mineral diets. However, the explanation on this is still not clear as measurements of absorption and digestion of supplemental trace minerals are generally difficult to make because of the complexity of endogenous mineral excretion. Numerically abdominal fat pad was observed to be highest in birds fed diet without silicon oxide diet compared to the chickens fed diets supplemented. All the litter score values assessed were similar. This result disagrees with the findings of Tran *et al.* (2015) who reported no significant differences as the levels of silicon oxide in the diets of broiler chickens increased. However, it was observed that all the treatment groups had a good litter score. This may be as a result of the feed ingredient used and season of rearing which may have reduced litter pH which decreased the conversion of NH_4^+ to NH_3 thereby reducing nitrogen losses from litter.

Table2: Carcass characteristics of broiler Chickens fed varying level of silicon oxide in the diets

Parameters	Silicon oxide levels (%)				SEM
	0.00	10	20	30	
Live weight (g)	2386.37 ^d	2760.00 ^b	3346.70 ^a	2406.70 ^c	0.12
Carcass weight (g)	1900.00 ^c	2193.04 ^b	3120.47 ^a	1900.08 ^c	2.29
Dressing (%)	69.60 ^b	81.89 ^a	79.58 ^a	80.46 ^a	1.98
<u>Prime cuts and organ weights expressed as % of dressed weight</u>					
Breast	18.58 ^c	21.99 ^b	34.27 ^a	32.62 ^a	2.68
Wings	2.56 ^c	2.81 ^c	4.54 ^a	3.94 ^b	0.20
Thigh	2.43 ^d	4.42 ^c	6.92 ^a	5.80 ^b	0.36
Drumsticks	2.10 ^d	2.75 ^c	5.20 ^a	4.03 ^b	0.30
Back	9.23 ^b	14.66 ^a	14.98 ^a	13.36 ^a	1.36
Liver	0.94	1.03	0.99	0.91	0.08
Heart	0.56	0.52	0.54	0.51	0.05
Kidney	0.15	0.14	0.12	0.16	0.05
Gizzard	0.67 ^b	0.79 ^{ab}	0.75 ^{ab}	0.93 ^a	0.10
Abdominal fat	0.70	0.68	0.56	0.69	0.11
Spleen	2.11 ^a	1.22 ^b	1.11 ^b	0.80 ^b	0.22
Shank	1.23 ^d	2.41 ^c	3.30 ^b	4.40 ^a	0.23

a, b, c, d= Means with different superscript on the same row differ significantly ($P < 0.05$)

SEM = Standard Error of Means

Table 3: Visual Scoring of Litter Quality at each Growth Phase

Growth phase	Silicon Oxide (g/kg)				SEM
	0.00	10	20	30	
Starter	2.66	2.42	2.32	2.50	1.96
Finisher	2.98	2.65	2.63	2.76	1.87

SEM = Standard Error of Means

CONCLUSION and Application

Dietary supplementation with silicon oxide may improve carcass quality and reduce moisture in litter. It was concluded that, under our study conditions, the feeding of 20g silicon dioxide /100kg diet offers potential economic benefits in terms of carcass characteristics and reduced moisture content in the litter of broiler chickens.

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