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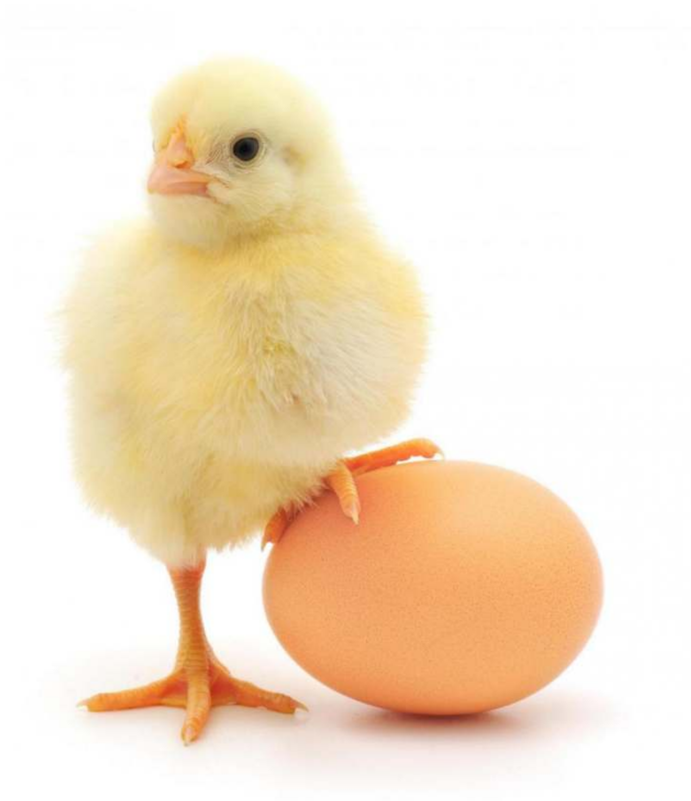

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Effects of Nutrient Density and Photoperiod on the Performance and Abdominal Fat of Broilers

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Abstract: The study investigated the effects of photoperiod and nutrient density on the performance and abdominal fat of broilers. Treatments consisted of a factorial arrangement of two diets containing 3200kcal/kg ME and 23% Protein and 2800kcal/kg ME and 18% Protein administered to broilers under either 12hour light per day, 8hour light per day or 6 hour light per day for 8 weeks. Results at market age showed that no significant interactions existed between nutrient density and photoperiod for feed intake, body weight gain and feed gain ratio ($P > 0.05$, $P > 0.01$). Also no significant interactions existed between factors for protein retention, fat utilization, available fibre, abdominal fat and cost to benefit ratio ($P > 0.05$, $P > 0.01$). Broilers subjected to low nutrient density diets experienced reduction in body weight gain and poorer feed to gain ratio ($P < 0.05$, $P < 0.01$). There was significant reduction in feed intake and abdominal fat of broilers exposed to only 6 hours of light per day as against the usual 12 hours of light per day ($p < 0.05$, $p < 0.01$). It was concluded that no meaningful interactions existed between nutrient density and photoperiod with respect to broilers performance. However, reducing photoperiod to 6 hours per day could be used as a tool for reducing abdominal fat hence, reducing sudden death syndrome and upgrading carcass quality of broilers.

Key words: Nutrient density, photoperiod, feed intake, weight gain, feed gain ratio, abdominal fat

Introduction

Broilers are nibblers and eat regularly when the temperature is constant and light is continuous. Growth and well being of broilers is influenced to a great extent by three components of light and their use. These components are photo regimen or the timing of light and dark period within a repeatable cycle, secondly the intensity of illumination and thirdly the wavelength or colour of the light. Also, a moderate protein restriction during early development has been reported to improve body weight gain and feed efficiency of broilers (Oju *et al.*, 1988). Both photo regimen and nutrient density reduction have been separately used as tools in early nutrient restriction to reduce cost of feeding, improve growth performance and reduce abdominal fat in broilers (Plavnik and Hurwitz, 1989; Rosety, 1980). Efforts to investigate the combined effects of photo regimen and nutrient density reduction on broilers have been little. Few reports in the temperate like those of Buckland *et al.* (1971), indicate that a significant interaction existed between body weight, light treatment and dietary protein and energy. Buckland (1975) suggested that due to limited feeding time under intermittent lighting, the poorer quality diets may reduce growth performance of broilers. Cherry *et al.* (1978) however noted that higher energy diets with protein level proportionately increased, failed to increase body weight for intermittent light treatments. There seems to be no definite conclusion on interaction between nutrient density and light treatment with regards to broilers performance. This study was designed to investigate the possibility of such interaction under a tropical situation.

Materials and Methods

Three hundred and sixty day old unsexed broiler chicks were housed in light proof pens and exposed to both dietary and light treatments shown in Table 1.

Treatments consisted of a factorial arrangement of two diets, 23% Protein, 3200kcal/kg ME and 18% Protein, 2800 kcal/kg of ME with three photoperiods, 12-hour light 12-hour darkness, 8-hour light 16-hour darkness and 6-hour light, 18-hour darkness. There were then 6 treatments in all, each replicated thrice with 20 birds per replicate. Diets and water were supplied *ad libitum to* broilers in each group. Weekly records of feed intake and weight gain were taken.

A metabolic study was conducted at the 3rd week of the experiment. Weighed quantities of feed were supplied and faecal samples collected over a 72-hour period using total collection method. The faecal samples collected were oven dried at 60^{o}C for 24 hour weighed and ground prior to chemical analysis.

The proximate analyses of the faecal sample and the feed samples were carried out using the method of AOAC, (1980).

At the end of the eight weeks, 3 broilers were randomly selected from each replicate group, weighed and slaughtered by exsanguination. Carcass weight was

Table 1: experimental diets and photoperiods

Diet *Photoperiod	23% P 3200 kcal/kg 12 HL:8 HL:6HL	18% P 2800kcal/kg 12 HL:8 HL:6 HL
Basal Ingredient	40.60	40.60
Soybeans Cake	30.84	17.00
Brewers Dry Grain	10.00	16.22
Maize Offal	8.00	12.45
Blood Meal	3.03	3.00
Palm Oil	4.78	1.91
Bone Meal	2. 69	2.95
Oyster Shell	0.26	0.10
Grit	-	5.72
Total	100.00	100.00
Analyzed nutrient content		
Dry matter %	95.85	95.98
Protein %	21.98	17.26
Crude fat %	6.58	3.71
Crude Fibre %	5.15	4.98
ME (Kal/kg)	3161	2766

Basal Ingredients: Yellow Maize 40%, salt 0.25%, DL - Methione 0.1%, Vit. min premix 0.25%, supplied per kg of diet Vitamin A (8000IU), Vitamin D_3 (1200IU), VitaminE(3IU), VitaminK_3 Kastab (2mg), Vitamin B_2- Riboflavin (8mg), Vitamin B_3 - Nicotinic acid (10mg), Vitamin B5-Panthotenic acid (150mg), Manganese (Mn) (80mg), Zinc (Zn) (50mg),Copper(Cu) (2mg), Iodine (I) (1.2 mg), Cobalt (Co) (0.2mg), Selenium (Se) (0.1mg).
*12HL = 12-hour light, 8HL = 8-hour light, 6HL= 6-hour light

taken after evisceration. The adipose tissue surrounding the gizzard and intestine, extending within the ischium and surrounding the cloaca, bursal of fabricius and adjacent abdominal muscles was collected and weighed as the abdominal fat. Economic parameter considered was determined using the prevailing market prizes of ingredients used in the diets, cost of medication and that of broilers on live weight basis.
The data collected were subjected to the analysis of variance as described by Steel and Torrie (1980) for a completely randomized design. Significant differences in means were tested at 1 and 5% using Least Square Difference (LSD).

Results

The effects of nutrient density and photoperiod and their interaction on the performance of broilers are shown in Table 2. There was no significant increase in feed intake with reduction in nutrient density ($P > 0.05$, $P > 0.01$). However, body weight gain was significantly reduced from 1566g to 1419g, while feed gain ratio was significantly increased from 2.69 to 2.95 by reduction in nutrient density ($P < 0.05$, $P < 0.01$).
Reduction in photoperiod to 6 hours of light per day on the other hand significantly reduced feed intake from 4397g to 4027g ($P < 0.05$, $P < 0.01$). However, body weight gain and feed to gain ratio were rot significantly affected ($P > 0.05$, $P > 0.01$). There was no significant interaction between nutrient density and photoperiod on feed intake, weight gain and feed to gain ratio ($P > 0.05$, $P > 0.01$). Neither reduction in nutrient density nor varying photoperiod nor their interaction significantly affected broilers livability ($P > 0.05$, $P > 0.01$). Abdominal fat content of broilers was significantly reduced from 34.5g to 21.4g by reduction in photoperiod to 6 hours daily ($P < 0.05$, $P < 0.01$). However, this parameter was not significantly influenced by nutrient density nor its interaction with photoperiod ($P > 0.05$, $P > 0.01$).
Cost to benefit ratio was not significantly influenced by either nutrient density or photoperiod nor their interaction ($P > 0.05$, $P > 0.01$).
Table 3 shows the effect of nutrient density and photoperiod on the nutrient utilization by broilers. Protein retention and fat utilization were significantly reduced in broilers subjected to low nutrient density diet ($p < 0.05$, $p < 0.01$), while fibre availability was comparable among birds ($p > 0.05$, $p > 0.01$). On the other hand, varying period of photoperiod had no significant effect on nutrient utilization neither did the interaction between nutrient density and photoperiod ($p > 0.05$, $p > 0.01$).

Discussion

Broilers subjected to poor nutrient density had comparable feed intake with their counterparts on diets with higher nutrient density indicating an attempt to satisfy their nutrient needs. Despite this attempt, weight gains and feed to gain ratios of broilers under poorer nutrient density was lower probably due to low protein content of the diet. Plavnik and Hurwitz (1990) reported that birds fed low protein diet in an experiment gained least body weight and did not recover the lost body weight as measured at 56 days of age. In contrast to the present findings improvement in feed efficiency was reported. It has been postulated that live weight gain is mostly the deposition of protein, fat or water (Boekholt *et al.*,1994). Observations in this study showed that both dietary protein and fat were poorly utilized by birds subjected to diets of low nutrient density. This in effect might have accounted for the poor performance of those broilers. However, Buckland *et al.* (1971) reported that broilers have the ability to alter their feed intake depending on the nutrient density of the diet and will grow at rate similar to control.
Expectedly, reduction in feeding time for broilers under reduced photoperiod resulted in reduced feed intake. Guhl (1953), noted that chicks will not eat at a light intensity below one foot candle. Birds depend on sight for food seeking and so the visual organs are well developed and strategically placed. Rosety (1980), reported that visual cells of avian retina have glycogen bodies in the cytoplasm adjacent to the photoreceptors which disappear when birds are placed in darkness over a prolonged period and reappear when turned to light. Forbes and Injidi (1979), also reported that exogenous melatonin depresses feed intake of

Table 2: Effects of Nutrient Density, Photoperiod and theirinteraction on the performance of broilers

Treatment	Feed Intake (g)	Weight gain (g)	Feed/gain ratio	Mortality %	Abdominal fat (g)	Cost/ Benefit ratio
Diet density	NS	*	*	NS	NS	NS
23% P, 3200 Kcal/kg	4206	1566[a]	2.69[b]	10.64	27.1	0.74
18% P, 2800 Kcal/kg	4185	1419[b]	2.95[a]	7.87	27.4	0.75
**photo period	*	NS	NS	NS	*	NS
12 HL, 12 HD	4397[a]	1542	2.85	9.63	34.5	0.76
8 HL, 16 HD	4162[b]	1477	2.82	9.72	26.0[b]	0.77
6 HL, 18 HD	4027[c]	1459	2.76	7.68	21.4[c]	0.71
Interaction						
Diet x photo period	NS	NS	NS	NS	NS	NS
SEM	132.61	60.45	0.10	1.28	4.70	0.02

*Means within column carrying different superscripts differ significantly ($P < 0.01$). **12 HL, 12 HD - 12 hour light, 12 hour darkness, 8 HL, 16 HD - 8 hour light, 16 hour darkness, 6 HL, 18 HD - 6 hour light, 18 hour darkness

Table 3: Nutrient Utilization as affected by Nutrient density, photoperiod or their interaction

Treatment	protein %	fat%	fibre%
Diet density	*	*	NS
23% P, 3200 Kcal/kg	71.47	83.47[a]	42.61
18% P, 2800 Kcal/kg	66.90[b]	79.69[b]	39.32
**photo period	NS	NS	NS
12 HL, 12 HD	69.45	80.50	41.68
8 HL, 16 HD	69.04	82.00	38.96
6 HL, 18 HD	69.08	82.25	47.28
Interaction			
Diet x photoperiod	NS	NS	NS
SEM	1.62	1.49	3.35

*Means within column carrying different superscript differ significantly ($P < 0.05$).

** 12 HL, 12 HD - 12 hour light 12 hour darkness
8 HL, 16 HD - 8 hour light 16 hour darkness
6 HL, 18 HD - 6 hour light 18 hour darkness

chickens that have been exposed to darkness. Melatonin levels are high during the scotophase (darkness) and low during photophase (light period).

Despite the lower feed intake in broilers exposed to long hours of darkness, their body weight gains and feed gain ratios were still comparable with those of broilers exposed to the usual twelve hours of light per day, presumably, due to lower energy expenditure on physical activity.

Results emanating from this study indicate there is no significant interaction between nutrient density and photoperiod as far as broilers performance is concerned. This is however contrary to earlier reports by Buckland (1975), who stated that due to limited feeding time under intermittent light, the poorer quality diets may reduce growth performance of broilers. Also, Buckland *et al.* (1971) reported a significant interaction between body weight, light treatment and dietary protein and energy. Cherry *et al.* (1978), however noted that higher energy diets with protein proportionately increased failed to increase body weight for intermittent light treatments. Within treatments, economic gains in terms of cost to benefit ratio were comparable. No significant interaction between nutrient density and photoperiod for this parameter has been reported. Abdominal fat, a factor that downgrades carcass was significantly reduced by reducing lighting to six hours per day, suggesting that this could be a tool in reducing abdominal fat hence enhancing carcass quality. This observation is in line with those of Plavnik and Hurwitz (1985) who attributed reduction in fat deposition to delayed hyperplasia or hypertrophy or both. Again no interaction occurred between nutrient density and photoperiod for abdominal fat of broilers.

In conclusion this study has shown that no meaningful interaction existed between nutrient density and photoperiod with respect to broilers performance. However within treatments, certain significant effects were observed, notably, reduced body weight gains and poor feed to gain ratios of broilers subjected to low nutrient density diets. Also, reduction in feed intake and abdominal fat in broilers exposed to six hours of light per day for eight weeks as against the usual practice of natural twelve hours of light per day is worth noting.

References

Association of Official Analytical Chemists (AOAC), 1980. 13th Ed., Washington, D.C. PG., 21-47.

Boekholt, H.A., P.H. Vandergrintein, V.V.A.M. Scherurs, M.J.N. Los and C.P. Leffering, 1994. Effect of dietary energy restriction on retention of protein , fat and energy in broiler chickens . Br. Poult. Sci., 35: 603-614.

Buckland, R.B., 1975. The effect of intermittent lighting programmes on the production of market chickens and turkeys. Worlds Poult. Sci. J., 31: 262-270.

Buckland, R.B., H.C. Gasperdone and D.B. Bragg, 1971. Interaction of strain , density and ration with two light systems on broilers performance. Can. J. Anim. Sci., 51: 613-619.

Cherry, J.A., W.L. Beane and W.D. Weaver Jr., 1978. The influence of dietary energy on the performance of broilers reared under different lighting regimes. Poult. Sci., 57: 998-1001.

Forbes,J.M. and M.H. Injidi, 1979. Feeding and sleeping in chickens following melatonin and triiodothyronine injections. J. Physiol., 296: 57-58.

Guhl, A.M., 1953. Social behaviour of the domestic fowl. Kansas Agric. Expre. Sta. Tech. Bul., 73.

Oju, E.M., P.E. Waibel and E. Noll, 1988. Early protein undernutrition and subsequent realimentation in turkeys 1: Effects on performance and body composition. Poult. Sci., 67: 1750-1759.

Plavnik, I. and S. Hurwitz, 1985. The performance of broiler chicks during and following an every feed restriction at an early age. Poult. Sci., 64: 348-355.

Plavnik, I. and S. Hurwitz, 1989. Effect of dietary protein, energy and feed pelleting in the response of chicks to early feed restriction. Poult. Sci., 68: 1118-1125.

Plavnik, I. and S. Hurwitz, 1990. Performance of broiler chickens and turkeys subjected to feed restriction or to feeding of low protein at low sodium diets at an early age. Poult. Sci., 69: 945-952.

Rosety, M., 1980. Influence of light on development of glycogen bodies in visual cells of the avian retina. An experimental study. Mortol normal Y Pato log, 44: 323.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and procedures of statistics Biomedical approach. Mc.Graw Hill book. Co. Inc. New York Toronto, London, pp: 101-123.