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RESPONSE OF TWO DIFFERENT BROILER GENOTYPES TO DIETS CONTAINING COCOA POD HUSK

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ORIGINAL ARTICLE

ABSTRACT: *A total of 300 day old chicks from 2 commercial broiler genotypes were fed diets containing 0, 5, 10, 15 and 20 percent cocoa pod husk (CPH) for 33 days. Thereafter, all the chicks were fed a common finisher diet which was devoid of CPH until 56 days of age. Body weight, feed consumption, feed efficiency and carcass traits (eviscerated, gastro intestinal tract (GIT), feather and liver weights) were measured. Genotype × CPH level interaction was not significant in this study. Body weight of the genotypes differed significantly (P<0.05) at 1, 33 and 56 days but not at 14 days. The different CPH levels however, elicited differences (P<0.05) in the body weight at 15 % and 20 % inclusion rates for ages 14 and 33 days. When fed a common finisher diet at 33 days, recovery in body weight was observed in broilers fed all but 20 % CPH diet by 56 days of age. Feed efficiency which declined beyond 5 % CPH level at 33 days showed an improvement in all broilers except those fed 20 % CPH. Eviscerated carcass, GIT and liver weights showed no differences among the diets. The results suggested that even though growth of chicks deteriorated beyond 10 % CPH by 33 days, advantage should be taken of the tremendous compensatory growth upon CPH withdrawal and thereby increase the starter CPH level to 15 percent.*

Key words: *Broiler, Cocoa Pod Husk, Diet, Genotype, Performance*

INTRODUCTION

In recent years, the once prosperous poultry industry in Ghana has taken a downwards turn due to shortage and high cost of inputs, particularly grains, which is a staple for humans. Traditionally, grains are included in poultry feed at levels of up to 60-70% (Teguia et al., 2004). This downwards turn of the poultry industry has created a serious crisis in meat supply and over-dependence on fish which constitutes about 66 % of the per capita daily protein consumption (Ince, 1983; Rhule et al., 2005). There is therefore an urgent need to find cheaper feedstuffs to partially replace grains.

Cocoa is cultivated on a larger acreage than any other tree crop in Ghana and the pod which accounts for 75% of the fruit, currently yields about 554,000 tonnes of dry cocoa husk annually (Rhule et al., 2005). Jahnke (1982) has reported that about 1.032 million metric tonnes of dry matter of cocoa pod was produced annually in tropical Africa. In Ghana, large quantities of cocoa pod husks are left to rot on cocoa farms except for small quantities that are used in the manufacturing of locally made soap. Cocoa could be used as a potential substitute for maize to reduce feed cost and help revive the once vibrant poultry industry.

Atuahene et al. (1985) and Sobamiwa and Longe (1999) have all reported favourable growth and carcass results when 10 % dietary cocoa meal was used to replace maize in broiler starter and finisher rations. Olubamiwa et al. (2002) have also reported that weight gain and feed conversion efficiency were depressed only beyond 10% inclusion rate of cocoa pod husk in starter cockerel diet. Boa-Amponsem et al. (1984) using locally available ingredients included up to 10% cocoa pod husk (CPH) in broiler starter diet with no significant deterioration in growth and carcass traits. All these workers used single breeds in their experiments, yet under extreme conditions of energy dilution, which high CPH levels may cause, genotypes of different growth potentials may react differently (Sorensen, 1985).

With the increase in the annual production of cocoa in the country with its attendant increase in CPH generation, the processing of cocoa pod husk for feeding livestock including poultry may become economical. The objective of this study was to investigate the performance of different commercial genotypes of broilers when fed high levels of dietary cocoa pod husk.

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MATERIALS AND METHODS

Genotypes and management

Three hundred broiler day old chicks (DOCs) were obtained from two commercial hatcheries. Each hatchery provided 150 DOCs of a particular genotype (A and B) for the study. Chicks were wing banded, weighed and brooded for 2 weeks. The brooder house was partitioned into 20 pens and each pen held 15 chicks of each commercial genotype. The 5 feed treatments of CPH (0, 5, 10, 15, and 20%) were assigned randomly to the birds in each of the 20 pens with 2 replications for each treatment. Chicks were then weighed and transferred to wire-floor range pens each measuring 2.04 m × 1.73 m. The stocking density in each range pen was 4 birds per square metre. The commercial genotypes, A and B were not intermingled within each pen.

All chicks were vaccinated against Gumboro, Newcastle and Fowlpox diseases at 1, 2 and 4 weeks of age respectively. Booster vitamins were provided via water medication twice every week. On days 33 and 56, one bird was randomly selected from each pen and sacrificed by cervical dislocation for carcass analysis.

Diets and feeding

Four diets were compounded in addition to the control by replacing 5, 10, 15 and 20 percent of maize from the control diet with CPH (Table 1). CPH was prepared from fresh cocoa pod husk mechanically dried to a moisture level of 10-12%. The five diets which were randomly allotted to 2 pens of each genotype were administered from day 1 till 33 days of age.

Thereafter a common finisher feed devoid of CPH containing 19% crude protein and 2900 kcal/kg (12.1 MJ/Kg) was fed to all genotypes regardless of previous dietary treatment. Both water and feed were provided *ad libitum.*

Table 1 - Composition of treatment diets indicating the varying levels of cocoa pod husk, maize and calculated analysis of ME, CP and CF

Ingredients	Diets				
Cocoa pod husk[1]	0.00	5.00	10.00	15.00	20.00
Maize	56.60	51.60	46.60	41.60	36.60
Fish meal[2]	23.00	23.00	23.00	23.00	23.00
Wheat bran	0.41	0.41	0.41	0.41	0.41
Copra cake	17.00	17.00	17.00	17.00	17.00
Shell	1.00	1.00	1.00	1.00	1.00
Dicalcium phosphate	0.90	0.90	0.90	0.90	0.90
Vit./Min. mix[3]	0.50	0.50	0.50	0.50	0.50
Common salt	0.20	0.20	0.20	0.20	0.20
Choline Cl_2 (50%)	0.22	0.22	0.22	0.22	0.22
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.07	0.07	0.07	0.07	0.07
Calculated Analysis:					
Metabolisable Energy (ME), Kcal/kg	2816	2704	2593	2481	2370
Crude protein (CP), %	22.50	22.40	22.30	22.20	22.10
Crude fibre (CF), %	4.00	5.30	6.60	7.90	9.20

[1]Cocoa pod husk proximate analysis: dry matter (89.13 %), crude fibre (28.4 %), ash (7.48 %), crude protein (7.0 %), ether extract (2.36 %), metabolisable energy (1200kcal/kg); [2]Fish used was local anchovy containing 60 % crude protein; [3]1kg vit/min. mix provided: vitamin A (2 miµ), vitamin D3 (3 miµ), vitamin E(880 mg), vitamin K (250 mg), vitamin B12 (2.2 mg), vitamin B2 (2000 mg), Ca-patothenate (2000 mg), niacin (6600 mg), choline Cl_2 (88000 mg), vitamin B1 (200 mg), vitamin B6 (12 mg), Folic acid (130 mg), biotin (0.2 mg), Zn-bacitracin (1000 mg), ethoxyquin (25000 mg), Mn (3.75 g), Zn (2.2 g), Iodine (0.11 g), Fe (65 g), Cu (0.11 g), Cobalt (0.03)

Measurements, design and statistical analysis

Each chick was weighed at 1, 14, 33 and 56 days of age. Apparent feed intake of chicks from each pen was measured at 33 and 56 days and was the difference between feed supplied and feed weighed back during these periods. Feed efficiency was estimated as grams of body weight gained per gram of feed consumed. Carcass data were obtained on randomly selected birds slaughtered from each pen on days 33 and 56 after starving for 18 hrs (n=20).

Feather weight calculated as the difference between body weight before and after defeathering was obtained. The gastro intestinal tract (GIT) was removed, emptied of its contents and weighed. The weight of the eviscerated carcass and liver were also recorded. Mortality was noted daily for each replicate.

The experiment was factorial, completely randomized design involving 2 genotypes and 5 CPH levels. Data were subjected to analysis of variance with genotype and diet as main effects and their interactions in a fixed effects model. Individual chick data were used for body weight related traits; whereas pen data were used for feed intake, feed efficiency and mortality traits. In case of mortality, subclass cells with zero observations were replaced by 0/4n (Zar, 1984) whilst carcass data were converted to percent of body weight before statistical analysis.

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RESULTS

Body weight and mortality

No significant interaction (P>0.05) was observed between genotype and diet for body weight at any age. Genotype B was significantly heavier (P<0.05) than A at the start of the experiment (Table 2). This significant difference in body weight however, disappeared at 14 days of age. Body weight did not vary among the chicks fed the different CPH diets initially (Table 2). By 14 days, significant effects (P<0.05) of diets on body weight were obvious. Diets with CPH level of up to 10% supported similar growth rates as the control at this age. Neither the differences between 10% and 15% nor 15% and 20% were significant (P<0.05). At 33 days, significant decline (P<0.05) in body weight occurred beyond 10 % CPH level. At 33 days, when the CPH diets were withdrawn, the only difference (P<0.05) in body weight at 56 days was between the control and 20% CPH level (Table 2). CPH had no effect on mortality of the birds fed different CPH levels neither were the genotypes affected (Table 2).

Table 2 - Means of body weight (g) and mortality (%) of the different genotypes fed diets differing in cocoa pod husk levels at various ages

Body weight (g)									
	Genotype			Diets (Cocoa pod husk levels)					
Age(days)	A	B	SEM	0	5	10	15	20	SEM
1	34.8^{b}	36.8^{a}	0.1	35.8	35.9	35.9	35.8	35.7	0.1
14	192.2	194.8	3.5	206.1^{a}	207.8^{a}	198.9^{ab}	184.7^{bc}	170.0^{c}	5.5
33	829.4^{b}	878.2^{a}	13.6	955.6^{a}	930.6^{a}	880.6^{ab}	800.2^{c}	693.3^{d}	21.5
Common Finisher Diet									
56	1942.1^{b}	2030.4^{a}	22.8	2058.3^{a}	2038.4^{ab}	1973.1^{ab}	1958.1^{ab}	1895.6^{b}	50.9
Mortality (%)									
33	4.0	6.0	1.1	3.3	8.3	5.0	5.0	3.3	1.8
56	6.7	7.3	1.3	5.0	10.0	8.3	8.3	3.3	2.0

^{a,b,c,d} on means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

Feed intake and efficiency

Feed intake and efficiency of the genotypes and the different CPH diets at the different ages did not interact. The chicks of the different genotypes consumed similar amounts of feed up to 33 days (Table 3). Cumulatively however (0-56 days), the difference between genotypes in the feed intake reached significant levels (P<0.05), the heavier B genotypes consuming more feed.

Dietary CPH level significantly influenced (P<0.05) feed consumption of the chicks to 33 days (Table 3). Those fed 20 % had the highest intake followed by 15% and 10% CPH inclusion. The chicks fed the control and 5 % CPH diets consumed similar amounts of feed. Feed efficiency did not vary between the genotypes at any age (Table 3). Birds fed the control and 5% CPH diets were the most efficient at 33 days whilst those fed 10, 15 and 20 % levels significantly differed (P<0.05) in a declining order. Feed efficiency of birds on 20% CPH diet still lagged behind those of the other levels at 56 days.

Table 3 - Means of feed intake (kg/bird) and feed efficiency (gain: feed) by genotype and diets at different ages

Feed intake (kg/bird)									
Period (days)	Genotype			Diets (Cocoa pod husk level)					
	A	B	SEM	0	5	10	15	20	SEM
0-33	1.80	1.86	0.0	1.72^{c}	1.70^{c}	1.86^{b}	1.85^{b}	2.02^{a}	0.0
0-56	5.08^{b}	5.29^{a}	0.1	5.01^{b}	5.03^{b}	5.19^{b}	5.24^{ab}	5.46^{a}	0.1
Feed efficiency (g/g×100)									
0-33	44.4	44.9	0.7	51.8^{a}	52.8^{a}	45.8^{b}	40.8^{c}	32.3^{d}	1.1
0-56	37.8	37.9	0.6	40.3^{a}	40.3^{a}	38.0^{a}	37.3^{a}	33.5^{b}	1.0

^{a,b,c,d} on means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

Carcass characteristics

Interactions between the main effects were not significant (P>0.05) for the carcass parameters. Genotypes had similar weight of eviscerated carcass at both 33 and 56 days of age (Table 4). The decline in eviscerated carcass weight of chicks fed the different diets at 33 days was not significant (P>0.05). CPH levels did not influence eviscerated carcass weight at 56 days. Genotype B, the faster growing strain had larger GIT than genotype A, at 33 days, but not at 56 days. CPH levels had no significant effect on this trait at any age though an increasing trend was apparent.

Genotypes did not differ in feather percent. However, birds fed the 20 % diet had poor feather development at 33 days, but not at 56 days. Both genotype and CPH level did not have any significant effect (P>0.05) on liver size of broilers.

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Table 4 - Mean (% of body weight) of carcass characteristics of the genotypes fed diets differing in cocoa pod content at various ages

Trait	Age	Genotype			Diets (cocoa pod husk levels)					
	(days)	A	B	SEM	0	5	10	15	20	SEM
Eviscerated carcass	33	67.7	68.2	0.4	68.5	68.8	68.1	67.8	66.7	0.6
	56	77.3	77.6	0.5	77.5	78.9	77.3	76.5	76.9	0.8
GIT	33	12.6[b]	15.1[a]	0.7	11.7	13.0	13.9	14.3	16.4	1.1
	56	9.6	9.1	0.4	9.2	8.7	9.4	10.1	9.3	0.6
Feather	33	7.3	7.2	0.1	8.0[a]	7.8[ab]	7.5[ab]	7.0[b]	6.0[c]	0.2
	56	6.6	6.6	0.3	6.1	5.7	7.5	7.0	6.7	0.5
Liver	33	2.6	2.7	0.1	2.5	2.6	2.7	2.8	2.9	0.2
	56	1.8	2.1	0.1	1.8	1.8	2.1	2.0	2.1	0.1

[a,b,c] on different means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

DISCUSSION

The performances of different broiler genotypes on diets containing varying levels of cocoa pod husk were generally similar. In this study, there was no significant interaction between genotype and diet for body weight at any age of broilers. This is in agreement with reports by Cahaner et al. (1987) and Boa-Amponsem et al. (1999) who also reported no significant interaction between cocoa pod meal and genotypes. At day 1, the mean body weight of genotype B was higher than genotype A and this could be attributed to variation in pre-natal growth rate between the two genotypes resulting from either genetic or maternal (egg size) effects. However, this difference disappeared after 14 days suggesting that there was an important maternal effect at play for this trait. Barbato et al. (1983) and Katanbaf et al. (1988) have both observed significant maternal effects in chicken which dissipated within 7 days of rearing. Subsequent differences (P<0.05) in body weight between the two genotypes at 33 and 56 days under similar dietary and husbandry conditions would be genetic. This supports the long held assertion that considerable genetic variation in body weight is still existent between chicken populations (Siegel et al., 1984; Boa-Amponsem et al., 1999).

Significant decline (P<0.05) in body weight that occurred beyond 10% CPH level at 33 days corroborates the findings of Sorensen (1985) who also reported similar growth response of the chicks fed continuously on the higher CPH levels (1% and 20%). Olubamiwa (2002) also reported that body weight gain was depressed beyond 10 % inclusion rate of cocoa husk meal in starter cockerels' diet. The decline in growth rate associated with feeding low density diets (high CPH levels) could be attributed to inadequate intake of nutrients from bulky diets (Boa-Amponsem et al., 1991).

At 33 days, when the CPH diets were withdrawn, tremendous compensatory growth occurred such that at 56 days, the only difference in body weight was observed between the control and 20 % CPH level suggesting that up to 15 % CPH may be included in a broiler starter diet provided CPH is withdrawn at 33 days. This compensatory growth virtually erased differences in feed intake observed at 33 days among chicks fed different CPH levels. The low feed efficiency observed in birds fed 20 % CPH diet as compared with birds fed on other levels of CPH at 56 days agrees with reports from Farrell (1974) and Boa-Amponsem et al. (1991) that greater consumption of low nutrient density diets (e.g. higher CPH diets) is associated with deterioration in feed efficiency.

Most of the carcass characteristics studied in this work were not adversely affected by the dietary treatments. The larger GIT of genotype B, the faster growing genotype, as compared with genotype A at 33 days is in agreement with findings of Lilja (1983) that faster growing birds develop larger GIT at an early age. No toxicity was associated with the feeding of CPH as liver size was not influenced significantly (P>0.05) by the different CPH levels.

CONCLUSION AND RECOMMENDATIONS

The broiler genotypes did not show differential response as the dietary CPH level increased indicating that the fastest growing genotype should be used regardless of the CPH level. The role of the finisher diet in regimes where the starter diet contained high CPH levels has been emphasized. In this trial, the differences between the body weights of birds on the different CPH levels at 33 days practically disappeared at 56 days of age. Thus even though growth of chicks deteriorated beyond 10% CPH levels in the starter diet, advantage could be taken of the compensatory growth from the finisher diet and thereby increase the starter CPH level to 15%.

REFERENCES

Atuahene CC, Adams C and Adomako D (1985). Cocoa pod-husks in starter diets of broiler chicken. Proceedings of the 9th International Cocoa Research Conference, Lome, Togo, 1984, Pp. 495-500.

Barbato GF, Siegel PB and Cherry JA (1983). Inheritance of body weight and associated traits in young chickens. Zeitschrift für Tierzüchtung und Züchtungsbiologie, 100(1-5): 350-360.

Boa-Amponsem K, Agudu EW and Manu M (1984). Effect of cocoa pod husk on broiler performance. Proceedings of the 9th International Cocoa Research Conference, Lome, Togo, 12–18 February, 1984, Pp. 501-504.

Boa-Amponsem K, Dunnington EA and Siegel PB (1991). Genotype, feeding regimen and diet interactions in meat chicken: Growth, organ size and feed utilization. Poultry Science, 70: 680-688.

Boa-Amponsem K, Dunnington EA, Baker KS and Siegel PB (1999). Diet and immunological memory of lines of white Leghorn chickens divergently selected for antibody response to sheep red blood cells. Poultry Science, 78: 165-170.

Cahaner A, Dunnington EA, Jones DE, Cherry JA and Siegel PB (1987). Evaluation of two commercial broiler male lines differing in feed efficiency. Poultry Science, 66: 1101 - 1110.

Farrell DJ (1974). General principles and assumptions of calorimetry. Energy requirements of poultry, Morris TR and Freeman BM eds Edinburgh U.K: British Poultry Science, 15, Pp. 25-41.

Katanbaf MN, Dunnington EA and Siegel PB (1988). Allomorphic relationships from hatching to 56 days in parental and F_1 crosses of chickens selected 27 generations for high and low body weight. Growth,Development and Ageing, 52: 11-22.

Lilja C (1983). A comparative study of postnatal growth and organ developmental in some species of birds. Growth, 47: 317-319.

Olubamiwa O, Otun AR and Longe OG (2002). Dietary inclusion rate of cocoa husk for starter cocokerels. International Journal of Poultry Science, 1 (5): 133 – 135.

Rhule SWA, Wallace PA and Otchere EO (2005). The reproductive performance of breeding sows fed diets containing cocoa-cake with shell and dried cocoa husk. Ghana Journal of Agricultural Science (1): 57-62.

Siegel PB, Dunnington EA, Jones DE, Ubosi CO, Gross WB and Cherry JA (1984). Phenotypic profiles of broiler stocks fed 2 levels of methionine and lysine. Poultry Science, 63: 855-862.

Sobamiwa O and Longe OG (1999). Utilization of alkali-treated cocoa husk in broiler finisher diets. Nigeria Journal of Tree Crop Research, 3: 11-19.

Sorensen P (1985). Poultry Genetics and Breeding. Edited by Hill WG, Manson JM and Hewitt D. British Poultry Science Ltd. Longmann Group Harlow England.

Teguia A, Endeley HNL and Beynen AC (2004). Broiler performance upon dietary substitution of cocoa husks for maize. International Journal of Poultry Science, 3 (12): 779-782.

Zar JH (1984). Biostatistical Analysis. 2nd Edition Prentice-Hall Inc., Englewood. Cliffs NJ.

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