Effect of cassava meal supplemented with a combination of palm oil and cocoa husk as alternative energy source on broiler growth

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SUMMARY

This study was conducted to investigate the effects of substituting maize (*Zea mais*) with cassava meal supplemented with palm oil and cocoa husk on broiler performance. A total of 320 day-old Arbor Acres broiler chicks were distributed into 16 pens of 20 birds balanced for sex and initial body weight (39.7±1.02 g). Each of the experimental diets, T0 (control without cassava) and 3 other diets T50, T75 and T100 with respectively 50, 75 and 100% of maize replaced with cassava flour meal, supplemented with 3% palm oil and 1% cocoa husk was randomly fed to 4 groups in a completely randomized design. Feed and water were distributed *ad libitum* during the 49-days trial. The T50 diet induced the highest bodyweight (BW) with 2127g by comparison with birds under diet T100 (1700g). Nevertheless, there was no significant difference (P>0.05) between treatments T0, T50, and T75 for BW. Feed conversion ratio (FCR), and the cost of a kilogram of body weight were increased with cassava inclusion level. When compared with T0, birds fed T75 and T100 recorded significantly (P<0.05) higher FCR. However, there was no significant difference between treatments T0 and T50 for FCR. The smallest carcass yield, intestinal weight and intestinal density were recorded by diet T100 as compared to T0, T50 and T75. In conclusion, cassava meal supplemented with 3% palm oil and 1% cocoa husk can substitute maize up to 75% in the diets of starter and finisher broiler without any adverse effect on performance.

Keywords**:** broiler chicken, cassava root meal, cocoa husk, maize substitution, palm oil

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INTRODUCTION

The proportion of maize in monogastric tropical diets ranges from 50 to 70%, which implies that increasing cost of maize as is being currently experienced due to low level of production and higher consumption rates by man and agro-industries. The high cost of feed is mainly responsible for the high cost of animal's product. In Cameroon, the bulk of the feed cost arises not only from protein concentrates such as soybean meal but also from the maize which is the main energy concentrate. There is constant need to search for locally available and cheaper sources of feed ingredients which attract less competition between human and livestock/agro-industries. One of advocated alternative for partial replacement of maize in animal diets is the processed cassava root meal (Aina and Fanimo 1997; Garcia and Dale 1999; Akinfala et al. 2002; Salami and Odunsi 2003; Mafouo et al. 2011).

Apart from the hydrocyanic acid content, one of the greatest limitation in the use of cassava root meal is its poor texture and dustiness associated with the products cause crop impaction and irritation of the respiratory tract of animal unless the feed is pelleted or some oil is added to it (Chhay Ty et al. 2003; Ukachukwu 2005). Studies with broiler chickens have shown that performance declines progressively as the amount of cassava root meal is increased in the diet (Ojewola et al. 2006; Mafouo et al. 2011). Several studies on the diet of broiler chicks, broiler finisher chickens, growing pullets and laying hens have been conducted and established the inclusion rates of palm oil and cocoa husk meal in these poultry rations. A maximum of 10% of cocoa husk was found suitable mainly at the expense of maize in male broilers starter diets (Olubamiwa et al. 2002). Ojewola et al. (2006) suggested that substituting palm oil supplemented cassava meal for maize at 25 and 50% seems profitable for productive performance of broiler, especially, when maize is costly and scarce. While so much has been reported on cocoa husk and palm oil separately in the diets of broiler containing cassava, there is dearth of information on their association on valorization of this energy source in poultry diets.

The present study was conducted to assess the effect of substituting maize with supplemented palm oil and cocoa husk cassava meal on the performance of broiler chickens.

MATERIAL AND METHODS

Study site

The experiment was conducted at the poultry unit of the Teaching and Research Farm of the University of Dschang (UDs), Cameroon. This school farm is located at latitude 05°26’ North and longitude 10°26’ East in the Western highland of Cameroon. The climate of the region is characterized by average mean daily temperature of 21°C. Average rainfall is about 2000 mm per year.

Animals

The experimental birds were from a flock of Hybro commercial line (Eurobird, Hendrix Genetics Company) broiler chicks acquired from a local hatchery and litter-brooded to 21 days of age at a density of 20 birds/m^2. Birds were given vaccines in drinking water against Newcastle disease and Infectious Bronchitis on the 8th day with a booster dose on the 23rd day of age, and against Gumboro disease on the 10th day of age. Coccidiosis prevention was done using Amprolium$^{(R)}$ (commercial trade) for 3 consecutive days per week from the 2nd to the 5th week of age. Birds were administered commercial antistress (Aliseryl$^{(R)}$) in drinking water during the first 3 days upon arrival, after each vaccination, weighing session and transfer from brooding to finishing house.

Table 1. Composition (%) and calculated chemical composition of the experimental diets

Ingredients (%)	Starter (1-21 days)				Finisher (22-49 days)			
	T_0	T_{50}	T_{75}	T_{100}	T_0	T_{50}	T_{75}	T_{100}
Maize	52.5	26.25	13.12	0	60	30	15	0
Wheat bran	10	0	1	0	10.5	9	1.5	1
Cassava	0	26.25	39.37	52.5	0	30	45	60
Cocoa husk	0	1	1	1	0	1	1	1
Palm oil	0	3	3	3	0	3	3	3
Cotton seed meal	7	8	1.5	0	6	0	2.5	2.5
Soybean meal	21	24.5	32	32	14	20	20	19
Fish meal	3.5	5	4	6	3.5	1	4	4
Bone meal	0	0	0.5	0	0	0.5	0	0
Oyster shell	1	1	0.5	0.5	1	0.5	0.5	0.5
Blood meal	0	0	0	0	0	3	2.5	4
Premix 5%*	5	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100	100
Calculated chemical composition								
Metabolisable energy (kcal/kg)	2946.43	2930.64	2895.01	2870.98	3013.3	3051.40	2986.78	2965.73
Crude protein	23.17	23.06	22.63	22.44	20.12	20.41	19.93	19.74
Energy/Protein	127.16	127.08	127.92	127.94	149.76	149.50	149.86	149.47
Lysine	1.46	1.45	1.50	1.55	1.34	1.36	1.34	1.39
Methionine	0.47	0.47	0.46	0.47	0.43	0.42	0.41	0.41
Calcium	1.08	1.23	1.13	1.15	1.06	0.97	1	1.03
Non-phytate Phosphorous	0.49	0.48	0.51	0.51	0.48	0.44	0.43	0.44

*[1]Premix 5%: CP=40%, Lysine= 3.3%, Methionine=2.40%, Ca=8%, P=2.05%, Metabolisable Energy=2078 kcal/kg; T_0 =Control; T_1 =50% maize +50% cassava + 1% cocoa husk + 3% palm oil; T_2 = 25% maize + 75% cassava + 1% cocoa husk + 3% palm oil; T_3= 100% cassava + 1% cocoa husk + 3% palm oil

Experimental diets and design

Four experimental diets including T0 designated as control (without cassava) and T50, T75 and T100 with respectively 50, 75 and 100% of maize replaced with cassava flour meal, supplemented with 3% palm oil and 1% cocoa husk were formulated for starter and finisher (Table 1). Each of the 4 experimental diets was fed to 16 birds (8 males and 8 females) chosen at random in a completely randomized design with 4 treatments replicated 4 times. Feed and water were distributed *ad libitum* during the 49-days trial. The cassava used in this experiment was obtained from the local markets.

At 49 days of age, 12 birds per treatment were randomly selected for carcass evaluation. The birds were fasted for 24 hours weighed and slaughtered as indicated by Jourdain (1980). In addition to weight of ready to cook carcass, abdominal fat, liver, heart, pancreas, gizzards, head, legs and the weight and length of the intestine were measured with the cut done from the start of the duodenal loop to the end of the cloaca. The density of the intestines was calculated as the ratio of the weight/length of the intestine.

Statistical analysis

Feed intake, weight gain, feed conversion ratio and carcass parameters were subjected to analysis of variance procedures as described by Vilain (1999) and in case of statistical difference, the means were compared using the Duncan's Multiple Range test. The SPSS computer software package was used for all statistical analysis.

RESULTS

The effects of replacement of maize with graded levels of cassava meal supplemented with palm oil and cocoa husk on growth performances of broilers are presented in Table 2. All parameters measured were significantly (P<0.05) affected by the diets. Irrespective to the periods, feed intake decreased as the level of substitution of maize with cassava meal increased from 50 – 100%. However, treatments T50 and T75 were comparable to T0 without cassava meal during finisher (22 – 49 days) and during the whole period (1 – 49 days) for this parameter. Birds fed diet with 100% of maize replaced with cassava meal supplemented with the mixture of palm oil and cocoa husk had significantly (P<0.05) the lowest final live body weight (1761 g) and body weight gain (1721 g) as compared to T0, T50 and T75 which were comparable (P>0.05) during the whole period. Birds fed diets containing 50 and 75% of maize replaced by cassava supplemented with palm oil and cocoa husk were not significantly different to T0 without cassava during 49 days trials.

Table 2. Effect of feeding cassava root meal supplemented with palm oil and cocoa husk as substitute for maize on broiler chickens growth performances

Periods (days)	Treatments				SEM
	T_0	T_{50}	T_{75}	T_{100}	
Feed consumption (g)					
1 - 21	993.16^{ab}	951.85^{a}	1044.76^{b}	979.66^{ab}	15.12
22 - 49	3947.51^{b}	3824.05^{ab}	3719.59^{ab}	3509.90^{a}	62.89
1 - 49	4940.68^{b}	4775.90^{ab}	4762.59^{ab}	4489.56^{a}	65.39
Life body weight (g)					
1 - 21	496.26^{a}	619.17^{b}	619.59^{b}	556.42^{ab}	17.82
22 - 49	2160.04^{b}	2166.85^{b}	2015.02^{b}	1761.30^{a}	50.53
Weight gain (g)					
1 - 21	456.66^{a}	579.57^{b}	579.98^{b}	516.82^{ab}	17.82
22 - 49	1664.28^{c}	1547.68^{bc}	1395.44^{b}	1224.52^{a}	50.21
1 - 49	2120.94^{b}	2127.25^{b}	1975.33^{b}	1721.84^{a}	49.11
Feed conversion ratio					
1 - 21	2.18^{c}	1.65^{a}	1.80^{ab}	1.90^{b}	0.06
22 - 49	2.39^{a}	2.48^{ab}	2.67^{b}	2.87^{c}	0.06
1 - 49	2.34^{a}	2.25^{a}	2.41^{ab}	2.58^{b}	0.04

a, b, c: Means with different superscript in each row are significantly different (P<0.05), SEM: standard error of means; T_0 =Control; T_1 =50% maize +50% cassava + 1% cocoa husk + 3% palm oil; T_2 = 25% maize + 75% cassava + 1% cocoa husk + 3% palm oil; T_3= 100% cassava + 1% cocoa husk + 3% palm oil

Table 3. Carcass yield, relative weight of organs (% LW), and intestine development of broiler chickens fed cassava meal supplemented with palm oil and cocoa husk as substitute for maize

Parameters	Treatments				SEM
	T_0	T_{50}	T_{75}	T_{100}	
Carcass yield (% of LW)	72.90^{b}	73.71^{b}	71.79^{b}	68.79^{a}	0.45
Head	2.16^{a}	2.53^{a}	2.49^{a}	2.68^{a}	0.06
Leg	3.75^{a}	4.10^{a}	4.08^{a}	4.11^{a}	0.12
Liver	1.68^{a}	1.65^{a}	1.55^{a}	1.70^{a}	0.042
Heart	0.41^{a}	0.40^{a}	0.43^{a}	0.43^{a}	0.012
Pancreas	0.17^{a}	0.20^{a}	0.19^{a}	0.18^{a}	0.00
Abdominal fat	1.10^{a}	1.15^{a}	1.38^{a}	1.55^{a}	0.11
Gizzard	1.37^{a}	1.29^{a}	1.28^{a}	1.35^{a}	0.037
Intestine length (cm)	211.63^{a}	203.50^{a}	201.50^{a}	198.00^{a}	3.39
Intestine weight (g)	110.13^{b}	111.88^{b}	102.63^{b}	81.13^{a}	3.61
Intestine density (g/cm)	0.53^{b}	0.55^{b}	0.51^{b}	0.41^{a}	0.017

a, b: Means ± SD with different superscript in each row are significantly different (P<0.05), SEM: standard error of means; T_0 =Control; T_1 =50% maize +50% cassava + 1% cocoa husk + 3% palm oil; T_2 = 25% maize + 75% cassava + 1% cocoa husk + 3% palm oil; T_3= 100% cassava + 1% cocoa husk + 3% palm oil

During the starter period (1 – 21 days), life body weight and weight gain were significantly higher with diets containing 50 and 75% of supplemented cassava meal with palm oil and cocoa husk compared to T0 without cassava.

Contrary to starter period, weight gain decreased as the level of cassava increased in the diets during finisher. Irrespective to the trial phase, feed conversion ratio was significantly poorer as the substitution level of cassava meal for maize increased from 50 to 100%. However, during starter, feed conversion ratio for birds fed diets T50, T75 and T100 was significantly better (1.65 – 1.90) than those fed control diet (2.18).

Except for carcass yield, intestine weight and density, relative weight of head, leg, liver, heart, pancreas, abdominal fat, gizzard and intestine length of birds were not significantly influenced (P>0.05) by dietary treatments (Table 3). Carcass yield, intestine length, intestine weight and density were numerically poorer as the substitution level of cassava meal for maize increased from 50 to 100%. Contrary to carcass yield and intestine characteristics, abdominal fat tend to increase as the level of cassava increased in the experimental diets.

Discussion

The results of this study have shown that feed intake decreased as the level of substitution of maize with cassava meal increased from 0 to 100%. The linear decrease in feed intake in this study is consistent with those reported by Ojewela et al. (2006) and Mafouo et al. (2011). However, up to 75% of substitution of maize with the mixture of palm oil and cocoa husk supplemented cassava meal in broiler diets had no significant effect on feed intake. This is consistent with Akinfala et al. (2002) who reported that up to 50% of maize replaced by cassava could be economical in situation where cassava is available at cheaper prices. This trend is also in agreement with the finding of Olubamiwa et al. (2002) and Ojewola et al. (2006) who respectively reported that the feed intake of cassava based diet supplemented with cocoa husk and palm oil by broilers and cockerels was not significantly affected. The significant depressed feed consumption in the group of birds fed diet containing 100% cassava meal compared to the control could be due to the poor texture and dustiness associated with cassava which cause impaction and irritation in the respiratory tract of chickens. Also, the poor texture of the dustiness cassava meal diets has been reported to affect feed intake and poor utilization of feed nutrients by broilers (Ukachuckwu 2005; Adeyemi et al. 2008).

In this study, the growth performances observed is evidence that substituting palm oil and cocoa husk supplemented cassava meal for maize up to 75% seems profitable for broiler production. During the production period (1-49 days), animals fed diets T0, T50 and T75 had comparable life body weight and body weight gain. This could be due to enhancement of nutrients absorption by the associative dynamic effect of palm oil and cocoa husk on cassava meal based diet. Adding palm oil (Le duc Ngoan et al. 1998; Seijas Yelitza et al. 2002; Chhay et al. 2003; Ukachukwu 2005) and cocoa husk in the diets (Olubamiwa and Longe 1999; Sobamiwa 1999; Sobamiwa and Longe 1999; Olubamiwa et al. 2002) improved texture, digestibility and reduced dustiness of cassava based diets in monogastric animals.

Irrespective to the period of the study, the feed conversion ratio was significantly poorer as the substitution level of maize with cassava meal increased. This finding is in agreement with the results of Olubamiwa et al. (2002), Akinfala et al. (2002) and Mafouo et al. (2011).

The carcass yield, relative weight of pancreas, intestine length, weight and intestine density tended to decrease as the level of cassava meal increased. This is not consistent with the study of Nwokoro and Ekhosuehi (2005) with graded level of cassava peel in cockerel diet. This finding is in agreement with the results of Mafouo et al. (2011) with graded level of cassava meal in broiler diets.

CONCLUSIONS

The result of this study indicated that substituting up to 75% of maize with cassava meal supplemented with the mixture of palm oil and cocoa husk gave comparable results compared to control diet with maize as source of energy. This level of substitution seems profitable for productive performances in situation of maize shortage or where maize is too expensive.

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