Growth Parameters, Carcass Characteristics and Meat Quality of Broilers Fed Mixture of Sun-dried Cassava Tuber Meal, Dried Brewers' Grains and Palm oil

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Abstract: An experiment was conducted to determine the value of the mixture of sun-dried cassava tuber meal (C), dried brewers' grains (B) and palm oil (P) (CBP-mix) based diets with a view to determining: its optimal dietary maize replacement level(s) in broiler finisher and pig diets; its effects on growth performance, carcass characteristics and meat quality of finisher broilers and pigs. Sun–dried cassava tuber meal (C), dried brewers' grains (B) and palm oil (P) were mixed at the ratio of 6:3:1 respectively to produce a compound feedstuff referred to as CBP-mix which had a crude protein content of 9.84%, ME value of 3.48Mcal/kg and CF content of 8.27%. Anak broiler finishers were fed diets containing 0%, 50%, and 100% CBP-mix substitution levels for maize, from 4 to 8 weeks of age. A significant increase in feed intake was observed as the level of CBP-mix in broiler finisher diets increased ($P < 0.05$). Broilers fed 100% maize replacement diet recorded significantly ($P < 0.05$) lower average daily weight gain than broilers finished on the 50% and 0% maize replacement diets. However, average daily weight gain of broilers fed the 0% and 50% maize replacement diets were similar ($P > 0.05$). Feed conversion ratio showed no significant differences ($P < 0.05$). No significant difference ($P < 0.05$) was observed in dressing percentage and yield of economically important carcass components at the end of the experiment when examined as percentage of liveweight. The abdominal fat, organ weight and organoleptic characteristics did not show any significant differences ($P > 0.05$). The result on feed cost analysis showed that total feed cost and feed cost per weight gain decreased significantly ($P < 0.05$) as the CBP-mix substitution levels for maize increased. [Report and Opinion. 2010;2(3):104-110]. (ISSN: 1553-9873).

Key words: Dried brewers' grains, sun-dried cassava tuber meal, palm oil, broilers, growth, carcass characteristics, meat quality

Introduction

Nutrition has a significant impact on meat quality and safety (Grashorn, 2005). Approximately 70% of the total cost of livestock diets is related to meeting energy needs (Smith *et al*, 2002). Thus, choosing the proper level of energy that will optimize growth, carcass quality and feed efficiency, while still allowing for profitable production is a major concern to any farmer. It has been consistently demonstrated that if essential nutrients are maintained in relationship to dietary energy, an increased growth rate and improved feed efficiency was observed as a result of increasing the level of dietary energy (Moran, 2001; Smith *et al*, 2002; Hess, 2004). It is generally accepted that savings can result if selection can be made among diets which support superior rates of growth rather than strict adherence to formulations conforming to predetermined set of nutrient specifications (Waldroup *et al*, 2001). In order to utilize the formulation, there must be plurality of available data confirming the reported animal response. Although higher energy levels may allow for more rapid gains or for a greater quantity of meat to be produced in a given time in order to minimize capital costs of housing, equipment and labour, the ingredient and production costs of higher energy diets in contrast to diets of lower energy density may negate the benefits of improved performance (Waldroup *et al*, 1990). Generally, the major difference in the cost of all monogastric diets is due to the price of maize and soybean (Grashorn, 2005). The relative advantage or disadvantage of using any of these diets has to be determined by the price of these ingredients at the time of use.

Sun-dried cassava tuber meal appears to be an alternative source of energy. Cassava is a high yielding tropical root crop and thrives well under relatively low soil fertility regimes and survives remarkably under wide climatic variations. However, the meal is dusty, contains very low crude protein and high content of cyanogenic glucosides (linamarin and lotaustralin) which produce the highly lethal hydrogen cyanide. These factors render its nutritive value much less than that of maize, as shown from many numerous scientific research (Udedibie *et al*, 2004; Udedibie *et al*, 2008; Enyenihi *et al*, 2008).

Dried brewers' grains, the by-product of the brewing industry, is relatively high in crude protein (about 28%) and crude fibre (about 12%) but low in digestible carbohydrates (Uchegbu and Udedibie, 1998). Palm oil is very rich in energy (about 8.2 Mcal ME) and can serve as a stabilizing agent to reduce dustiness. In addition, evidence exists suggesting the efficacy of palm oil as detoxicant of residual cyanide in cassava-based ration for monogastric farm animals (Okeke *et al*, 1985). With the characteristics of sun-dried cassava tuber meal, dried brewers grains and palm oil described above; it might be possible to develop a product called CBP -mix that could replace maize in poultry diets based on appropriate proportions.

In addition controversy exists regarding the influence of dietary energy levels on carcass composition and quality (Saleh *et al*, 2004). As the modern livestock industry increasingly targets further processed or cut-up parts, any change in composition or quantity of economically important parts is a concern. Carcass fatness is affected especially when dietary energy levels are changed (Morrissey *et al*, 1998). In general, carcass fatness will not change as long as the ratio of energy and protein are kept constant; otherwise, carcass fatness increases as dietary energy level increases. It is important to maintain a balance between energy and crude protein in formulating livestock diets. The study herein reported was therefore to investigate the value of the mixture of sun-dried cassava tuber meal (C), dried brewers' grains (B) and palm oil (P) (CBP-mix) based diets with a view to determining: its optimal dietary maize replacement level(s) in broiler finisher diets and its effects on growth performance, carcass characteristics and meat quality of finisher broilers.

Materials and Methods

Site of study: The experiment was conducted at the Teaching and Research Farm of the Federal University of Technology, Owerri, Imo State, Nigeria. Owerri is located in the south eastern part of Nigeria within the tropical rain-forest belt. It is at the altitude of 90m and the mean annual rainfall, temperature and humidity are 2500mm, 26.5-27.5^{0}C and 70-80% respectively. Federal University of Technology, Owerri, is located at latitude 5^o 27N and longitude 7^o 02 E (FDALR, 1985).

Experimental Diets: Sun-dried cassava tuber meal (C), dried brewers' grains (B) and palm oil (P) were weighed out at the ratio of 6:3:1 and thoroughly mixed to produce a compound feedstuff thereafter called CBP-mix. Three diets were formulated such that diet 1 (control) contained maize as the major source of energy; in diets 2 and 3, 50% and 100% of the dietary maize was replaced with CBP-mix, respectively (Table 1).

Table 1: Ingredient Composition of the Experimental Broiler Finisher Diets

Ingredients (%)	Diets		
	0% CBP (60% maize)	**30% CBP (30% maize)**	**60% CBP (0% maize)**
Maize	60.00	30.00	0.00
CBP-mix.	0.00	30.00	60.00
Soybean meal	18.00	18.00	18.00
Fishmeal	2.00	2.00	2.00
Blood meal	2.00	2.00	2.00
Palm kernel cake	10.00	10.00	10.00
Wheat offal	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00
Vit./Trace Min. premix*	0.25	0.25	0.25
DL-methionine	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**
Calculated Nutrient Composition			
Crude protein,%	18.57	18.90	19.23
Crude fibre,%	4.35	6.02	7.69
EE, %	5.10	6.69	9.07
Lysine, %	1.18	1.20	1.22
Methionine,%	0.69	0.59	0.59
Protein:energy ratio	157.75	155.29	152.91
M.E. (Kcal/kg)	2929.58	2934.98	2940.38

Experimental Birds: Ninety day-old broilers of Anak breed were procured from a commercial dealer in Owerri, Imo State and fed broiler starter mash for four weeks during the brooding phase and thereafter randomized into 3 groups of 27 birds. Each group was subdivided into 3 replicates of 9 birds each. Birds in each replicate were housed in a 1½ m x 2m pen and fed the experimental diets for 4 weeks. Feed and water were supplied *ad libitum* throughout the feeding trial period. The birds were weighed at the beginning of the trial and weekly thereafter. Feed intake was determined by weighing the feed offered and left-over the following morning.

Determination of Carcass Characteristics and Organoleptic Quality: The procedures for the measurement of carcass, organ weights and assessment of organoleptic quality were as described by FAO. (1991). Briefly, 18 birds (2 from each replicate) were selected after the termination of the feeding trial (8 weeks of age) and sacrificed. Birds of similar live weights were selected, except when none was available. Birds were starved overnight, slaughtered and dressed following conventional procedure. The weights of the carcasses and the organs were recorded. The pH of broiler breast muscle at twenty four hours postmortem was determined using a glass tipped pH Star - Probe (SFK Technology, Peosta, IA) calibrated in pH 4 and 7 buffer solutions.

Water holding capacity was evaluated using the methodology described by Okeudo *et al* (2005). The evaluation is based on measuring water loss when pressure is applied to the muscle. Muscle weighing approximately 10g each was cut from the cranial end of the right-side breast muscle, wrapped in a paper towel and pressed using a screw jack for one minute until all the free water was expelled. The difference in muscle weight before and after the procedure represents the water loss and was expressed as percentage of the initial sample weight. Water holding capacity (WHC) equals (weight difference / initial weight) x 100%. One drumstick from each carcass was used for the determination of cooking loss. Drumsticks were packaged individually in double layer polythene bags and boiled in water for 30 minutes and thereafter allowed to cool. The difference in weight of the drumstick before and after cooking was expressed as a percentage of the weight before cooking and referred to as the percent cooking loss. Approximately one half of the flesh from each of the remaining drumsticks were obtained and used for the assessment of organoleptic quality. Samples were washed individually in clean water, immersed for a few seconds in a brine solution (containing super-saturated brine diluted with an equal volume of water), packed in a transparent double layer polythene bag and tagged for identification. Thereafter, they were boiled in water for 30 minutes, cooled under room temperature and served to a panel of 18 assessors previously trained in basic organoleptic assessment procedure. Each panelist was required to masticate two samples and score for tenderness, juiciness, flavor and degree of likeness using the 9 points category rating scale (AMSA, 1978).

Statistical Analysis: The analysis of variance test was conducted for each parameter using analysis of variance option of the general linear models (GLM) procedures of SAS (SAS Institute, 1988). Mean separation was achieved by the least significant difference (LSD) test as described by Little and Hills (1978).

RESULTS AND DISCUSSION

There were significant diet related differences ($P < 0.05$) in the final liveweight of the broilers (Table 2). Broilers fed the 100% maize replacement diet (60% CBP-mix diet) were significantly ($P < 0.05$) smaller than broilers finished on diets containing 0% and 30% CBP-mix diets. The average daily weight gain of broilers fed the 0% and 30% CBP-mix diets were statistically similar but significantly ($P < 0.05$) higher than those fed the 60% CBP-mix diet. There were significant differences ($P < 0.05$) in average daily feed intake. The group fed the 60% CBP-mix diet consumed significantly ($P < 0.05$) more feed than the other two groups. Udedibie *et al* (2009) made similar report when finisher birds are fed diet containing 100% CBP-mix substitution level for maize; they tend to consume more feed, whereas the control group gained more weight. Udedibie *et al* (2004) also made similar observation when sun-dried cassava tuber meal replaced 75% of maize in broiler diets. The higher feed intake by the birds finished on the 60% CBP-mix diet might be due to the higher fibre content of the feed. High fibre levels in the diet of monogastric animals are associated with reduced nutrient digestibility and high feed intake (Rausch and Belyea, 2006).The feed conversion ratio increased as the dietary substitution levels of CBP-mix for maize increased. The cost of feed decreased with increasing CBP-mix level (Table 2) such that the

control diet was 7.31% and 12.78% more expensive than the 50% and 100% CBP-mix diets, respectively. This suggests that in practical terms the utilization of CBP-mix based diets would result in considerable savings in poultry feeding.

Table 2: Growth Performance of the Experimental Birds

Parameter	0% CBP-mix (60% maize)	30% CBP-mix (30% maize)	60% CBP-mix (0% maize)	SEM
Initial live weight (g).	852.50	854.07	849.60	1.31
Final live weight (g).	1936.98[a]	1926.67[a]	1886.67[b]	21.92
Average weight gain (g/b/d)	38.73[a]	38.31[a]	37.04[b]	0.52
Average feed intake (g/d)	136.97[c]	138.91[b]	141.97[a]	0.49
FCR (g feed/g gain)	3.54	3.63	3.84	0.16
Feed cost (₦/kg)	81.79	73.72	65.65	-
Cost of prod. (₦/kg broiler)	288.72[a]	267.60[b]	251.83[c]	13.69

[a, b] Means within a row with different superscripts are significantly (P < 0.05) different

Carcass and Organ Characteristics of the Experimental Birds

There were no significant differences (P > 0.05) in dressing percentage (Table 3). The internal organs yield, expressed as percentages of liveweight were not significantly (P > 0.05) affected by dietary treatments. Similarly, yield of shank, drum sticks and wings as well as abdominal fat were not affected (P > 0.05) by the treatments. This suggests that the dietary treatments did not result in any significant negative metabolic reactions or disorders that could affect muscle growth, lipogenesis / lipolysis or osteoblastic activity (Taylor *et al*, 2003).

Table 3: Carcass and Organ Characteristics of the Experimental Birds

Parameters	0% CBP-mix (60% maize)	30% CBP-mix (30% maize)	60% CBP-mix (0% maize)	SEM
Dressing percentage.	70.20	69.16	69.83	0.39
Organ proportions (%).				
Head	2.57	2.97	2.71	0.21
Neck.	4.32	4.56	4.15	0.27
Wings.	8.66	8.27	7.98	0.80
Drumstick.	10.08	10.19	9.84	0.75
Shank.	4.24	4.33	3.67	0.36
Heart.	0.40	0.41	0.36	0.03
Liver,gallbladder & bile	2.20	2.83	2.45	0.32
Gizzard.	3.41	3.14	2.73	0.34
Abdominal fat.	1.58	1.59	1.72	0.28
GIT.	6.00	5.47	5.96	0.30
Empty gizzard.	2.26	2.21	1.98	0.15

Meat Quality of the Experimental Birds

There were no significant differences (P > 0.05) in the intramuscular pH of breast muscle (Table 4). Reports indicate that as the muscle reaches a pH of 5.3, water binding potential is expected to be significantly reduced because at this pH the isoelectric point of myosin is attained (Sante *et al*, 1991). In this study, it is important to note that pH values at or below 5.3 were not observed. Thus, these results suggest that the breast muscles did not exhibit extremely rapid postmortem metabolism that could be indicative of pale, soft and exudative (PSE) like problems (Warris and Brown, 1987). There were no significant differences (P > 0.05) in water holding capacity (WHC) due to dietary treatments. This lack of differences in water holding capacity measures was expected since no differences in muscle pH values were detected among the treatments. There were also no significant differences (P > 0.05) in flavour, juiciness, tenderness and hedonic score but as the CBP-mix levels increased the organoleptic quality indices increased slightly. Despite the non-significant difference (P > 0.05) observed in tenderness, the values increased as the CBP-mix level increased, indicating that slightly less force

Table 4: Meat Quality of the Experimental Birds

Parameter	0% CBP-mix (60% maize)	30% CBP-mix (30% maize)	60% CBP-mix (0% maize)	SEM
Cooking loss	10.56	9.57	9.25	0.53
pH (24 h postmortem)	5.65	5.68	5.72	0.14
Water holding capacity	25.10	25.69	26.02	1.26
Tenderness.	7.33	7.56	7.69	0.17
Flavour.	6.87	7.00	7.11	0.13
Juiciness.	6.67	6.72	6.78	0.06
Hedonic score.	7.67	7.33	7.22	0.14

Scoring was based on the 9 point category rating scale: 1Extremely (tender / juicy /flavoured) = 9; very (tender / juicy / flavoured) = 8; moderately (tender / juicy / flavoured) = 7; slightly (tender / juicy / flavoured) = 6; neither (tender / juicy / flavoured) nor (tough / dry / unflavoured) = 5; slightly (tough / dry / unflavoured) = 4; moderately (tough / dry / unflavoured) = 3; very tough / dry / unflavoured) = 2; extremely (tough / dry /unflavoured) = 1. Hedonic scoring: Like extremely = 9; like very much = 8; like moderately = 7; like slightly = 6; neither like, nor dislike = 5; dislike slightly = 4; dislike moderately = 3; dislike very much = 2; dislike extremely = 1.

CONCLUSION

The results obtained from the experiment showed that: CBP-mix could replace up to 50% of maize in broiler finisher diets without incurring any reduction in average daily weight gain. Although the 100% replacement of maize with CBP-mix in broiler finisher diets resulted in a significant reduction in daily weight gain, feed cost per unit body weight gain was significantly lower, suggesting that higher profit margins could be achieved if CBP-mix completely replaced maize. Neither dressing percentage nor organ proportions showed diet–related differences indicating that the dietary treatments had no overt and adverse physiological/ metabolic action in the birds. Full replacement of maize with CBP-mix produced no significant effect on cooking loss, postmortem muscle pH, water holding capacity and organoleptic quality.

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