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Nutritional Evaluation of Cornflakes Waste in Diets for Broilers

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Abstract: A nine week feeding trial was conducted to assess the nutritional value of cornflakes waste in broiler diets. Maize and cornflakes waste were used in various proportions as energy sources such that diets T_1, T_2, T_3, T_4 and T_5 had maize at 100.0, 80.0, 60.0, 40.0 and 0.0 %; and cornflakes waste at 0.0, 20.0, 40.0, 60.0 and 100.0 % levels respectively. Data were collected on chemical composition of cornflakes waste and on the amino acid profile, nutrient digestibility, cooking loss and cooking yield of the meat from the broilers. Results showed that the cornflakes waste is higher in DM, CF and NFE but lower in CP, EE, ash, M.E. and methionine compared to maize. The highest nutrient digestibility was obtained in broilers fed 80.0% maize and 20.0% cornflakes waste mixture similar to the one from birds fed 100 % cornflakes waste as an energy source. This was an improvement over the digestibility of birds fed control diet at the starter phase. The results were attributed to the physicochemical changes that occurred during the processing of raw maize and other materials into cornflakes waste. Broilers fed 100 % cornflakes waste had higher ($p<0.05$) cooking loss and lower cooking yield compared to birds fed the control diet. Diet T_2 with 80% maize and 20% cornflakes waste produced broilers with better meat quality due to its rigid structure as a result of the low cooking loss.

Key words: Cornflakes waste, broiler diet, maize, nutrient digestibility

Introduction

There are high and wide fluctuations in ingredient costs. A situation that was aggravated by the banning of importation of conventional ingredients (maize, wheat) by the Federal Government of Nigeria. There is therefore an obvious need to source for alternative ingredients to replace the conventional ones. Energy giving ingredients usually form the bulk of broiler's diets and consequently carry the lion share of the cost of the finished diets. Maize is one of the most widely used energy ingredients in poultry diets (Carpenter, 1974). The competition between man and his animals for maize is on the increase particularly in the developing countries where the grains are the major staple food. Among the consequences of this are drastic drop in the annual output of feedmills and manufactured feeds as well as high cost of finished broilers (ready for market broilers). Ibiyo and Atteh (2005) and Babatunde and Hamzat (2005) separately reported the effects of high cost of feed ingredients on animal production, a situation that is leading to acute protein shortage in the diets of the citizens.

There is need to conduct more researches into the use of cheaper by-products and wastes for poultry feed. In an effort to reduce the cost of poultry production poultry nutritionists have to utilize by-products and wastes that are not directly utilizable by man (Ani and Okorie, 2005). Longe (1980) worked on biscuits crumbs. Patrick and Schaible (1980) mentioned it under the miscellaneous products (No 60:14). To the best of our knowledge, little or no information is available on the suitability and the appropriate levels of inclusion or the substitution value of cornflakes waste in the diets of broilers.

This work was therefore carried out to investigate the performance, digestibility, cooking loss and cooking yield of broilers fed cornflakes waste based diets.

Materials and Methods

Sources of Cornflakes Waste and Processing: Cornflakes waste used for this study was obtained from NASCO Foods in Jos. Cornflakes wastes are the rejects during quality control stage of cornflakes production. They usually have poor flakes. Asiedu (1989) described cornflakes as a hydrothermically treated maize product of world-wide popularity. The cornflakes waste was collected, and ground in a milling machine and sieved with 350mm sieve to remove any foreign body or debris like stones. Samples of the ground cornflakes waste were analyzed for their proximate composition (AOAC, 1990) (Table 1). Amino acid composition of the cornflakes waste was determined by the procedure of Spackman *et al.* (1958) (Table 2).

Experimental diets: Five experimental diets were formulated such that the control diet (Diet T_1) contained no cornflakes waste but 100% maize as energy source. Other diets contained maize and cornflakes waste as energy sources in the following proportions.
Diet T_2: 80% maize and 20% cornflakes waste
Diet T_3 : 60% maize and 40% cornflakes waste
Diet T_4: 40% maize and 60% cornflakes waste
Diet T_5: 0% maize and 100% cornflakes waste
The other ingredients were added as shown in Table 3.

Table 1: Proximate chemical composition of maize and cornflakes waste

Components (%)	Cornflakes Waste	Maize*
Moisture	5.30	12.00
Dry Matter	94.70	88.00
Crude Protein	6.74	9.40
Ether extract	3.80	4.20
Ash	0.14	1.90
Crude fibre	2.74	1.20
NFE	81.28	72.00
M.E. (Kcal/kg)	3330	3450

*West *et al.* (1988).

Table 2: Amino acid composition of the cornflakes waste (mg/100g portion).

Amino acids	Values	Amino acids	Values
Arginine	273	Tyrosine	124
Glycine + Serine	351	Threonine	109
Histidine	234	Valine	208
Leucine	503	Aspartic acid	410
Isoleucine	288	Glutamic acid	821
Lysine	180	Glysine	234
Methionine	79	Proline	144
Methionine +Cysteine	188	Serine	114
Phenylalanine	284		

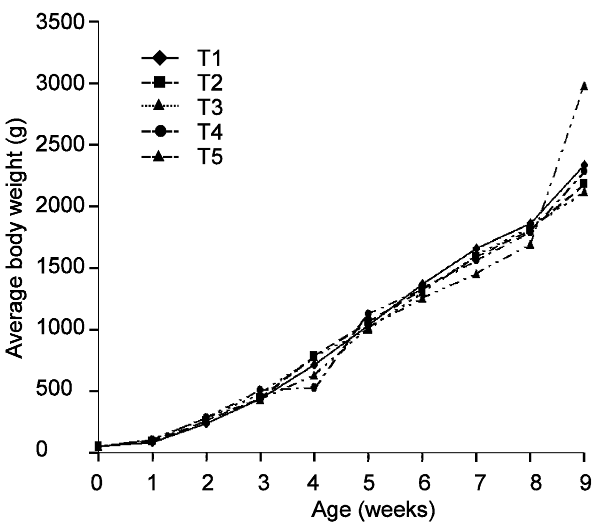

Fig. 1: Average weekly body weight of broilers fed cornflakes waste-based diets

Experimental birds: One hundred and fifty day-old broiler chicks of Ross breed were randomly allotted to the 5 experimental diets in randomized complete block (RCB) design. Each treatment group had 30 broiler chicks and was further sub-divided into 3 replicates of 10 birds each. The average initial weights of the chicks were taken. Subsequently, average weekly body weight and feed consumption were measured. Body weight gain and feed conversion were calculated from the data on body weight and feed consumption. Feed and water were offered *ad-libitum*. The trial lasted for 63 days.

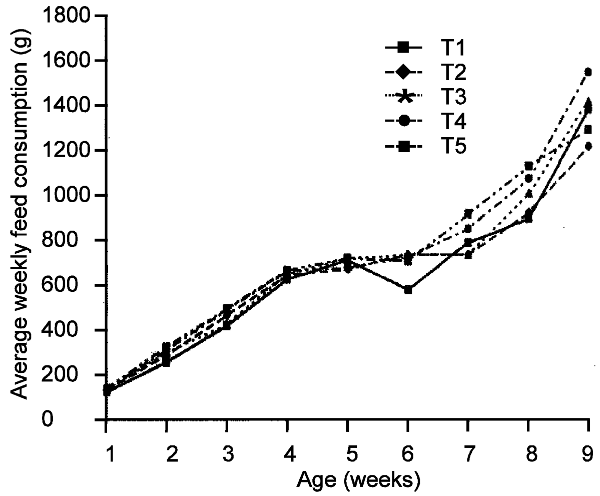

Fig. 2: Average weekly feed consumption of broilers fed cornflakes waste-based diets

Digestibility trial: Nutrient digestibility was measured at both 4th and 8th weeks. A total of 45 birds were used for the digestibility trial with 3 birds per replicate. Faecal collection lasted for 5 days after the 7 days adjustment period. Total collection method as described by Longe (1980; Dairo *et al.*, 2005; Aregheore and Abdulrazaki, 2005) was used. The faecal collected were dried at 80°C until constant weights were obtained. They were thereafter analyzed for the determination of proximate composition (A.O.A.C., 1990).The results obtained along with the proximate values for the feeds were used in calculating nutrient digestibility as described by McDonald *et al.* (1999).

Statistical analysis: Data collected were subjected to analysis of variance (Snedecor and Cochran, 1973). Mean separation was done where there were significant differences ($P<0.05$) using Duncan's New Multiple Range Test as outlined by Obi (1990).

Results and Discussion

The chemical composition of both maize and cornflakes waste is presented in Table 1 and the amino acid composition of cornflakes waste is shown in Table 2. Compared to maize cornflakes waste is higher in dry matter (DM), CF and NFE but lower in CP, EE, ash and metabolizable energy. This is in agreement with West *et al.* (1988) and Asiedu (1989) who separately reported that cornflakes has a slightly lower nutrient value compared to maize. The amino acid composition (Table 2) indicates that cornflakes waste is grossly low in methionine, which suggests that any broiler diet that is cornflakes waste based must be supplemented with this amino acid. None of the amino acids in cornflakes waste is high enough to meet the needs of the broilers. The data shown in Table 4 indicate significant

Table 3: Composition of the experimental diets

Cornflakes waste level (%)	0	20	40	60	100
	Diets				
Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	56.0	44.80	33.60	22.40	-
Cornflakes Waste	-	10.57	21.14	31.71	54.00
Soyabean Cake	32.25	32.88	33.51	34.14	34.25
Rice offal	3.00	3.00	3.00	3.00	3.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00
Premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Chemical Composition					
Crude protein	22.31	22.33	22.35	22.38	22.46
Crude Fibre	5.14	4.84	4.98	5.06	5.16
Ether extract	6.46	6.10	6.11	6.18	6.08
M.E.Kcal/g	3.20	3.14	3.15	3.09	3.04

Premix* to provide the following per kg diet: 440mg riboflavin; 720mg Ca; 2g pantothenate; 2.2g niacin; 2g choline chloride; 15mg folic acid; 15mg vit.B2; 165mg vit.D2; 100mgTocopherol acetate; 1700mg Cu; 200mgI2; 3000mgMn; 5000mgZn; 10,000mg Fe.

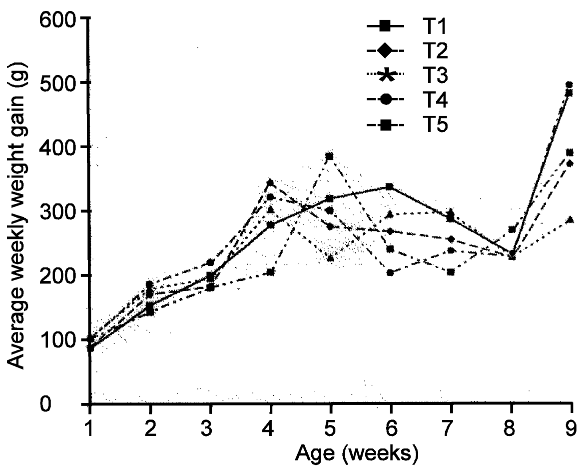

Fig. 3: Average weekly weight gain of broilers fed cornflakes waste-based diets

differences ($p < 0.05$) in the digestibility of DM, CP, CF and EE at the starter phase. The best nutrient digestibility was obtained in broilers fed 80% maize and 20% cornflakes waste as energy sources (T_2). Significantly ($p<0.05$) lower digestibility was obtained in DM, CP, CF and EE in birds fed 100% maize compared to those fed 100% cornflakes waste and diet T_2 at the starter phase. These results could be explained in line with the observation of Asiedu (1989) who report that during processing of maize to cornflakes, the raw material is subjected to certain physicochemical changes. As a result of which the starch in the maize is gelatinized and slightly hydrolyzed, or the starch granules are ruptured by high temperature and form a gel of soluble starch granules which makes the molecule more prone to amylase hydrolysis causing a relatively small increase in digestibility (Asiedu, 1989; Macrae *et al.,* 1997; McDonald *et al.,* 1999). Addition of 20% maize as an energy source produced a similar effect on digestibility as 100% cornflakes waste. Probably because the proportion of maize was not high enough to give remarkable changes.

The pattern however changes slightly at the finisher phase. Significant difference ($p<0.05$) was only observed in the digestibility of the crude protein. The digestibility of DM, CF, EE and NFE was not significantly ($p>0.05$) different.

Table 5 shows that T_{5-} broilers have significantly higher ($p<0.05$) cooking loss than cooking yield than those of other treatments but similar with those of T_1 birds. $T_{2\ and}$ $_{T3-}$ broilers had better ($p<0.05$) cooking yield than other broilers. The pattern of the broilers is depicted by Fig. 1 (average weekly body weight of broilers). This increased with the increase in the age of the birds and the level of feed consumption. Fig. 2 shows the pattern of feed intake which increased with the age of the birds and energy needs of the birds since birds feed primarily to meet their energy requirements. Fig. 3 is an indication of the average body weight gain which does not show a consistent pattern.

The low rate of cooking loss is considered an advantage in meat production since it ensures a better tenderness, juiciness and more flavourable meat compared to meat of high cooking loss. Kinder and Nancy (1978) described meat quality as the characteristic associated

Table 4: Apparent nutrient digestibility of broilers fed cornflakes waste diets.

Cornflakes waste level (%)	0	20	40	60	100	
	T_1	T_2	T_3	T_4	T_5	SEM
Starter phase (0-35 days)						
Dry matter	58.41^a	74.83^a	63.90^{ab}	63.79^{ab}	76.82^b	3.08*
Crude protein (%)	61.00^a	70.35^b	67.28^a	65.07^a	74.73^b	4.38*
Crude fibre (%)	22.50^a	28.41^b	26.81^{ab}	25.47^{ab}	27.82^b	4.19*
Ether extract (%)	53.00^a	58.66^b	54.15^{ab}	56.58^{ab}	59.25^b	44.6*
N2-free extract (%)	72.94	73.96	77.24	71.86	74.22	2.86^{NS}
Finisher phase (36-63 days)						
Dry matter (%)	76.31	76.43	78.44	78.16	78.13	1.57^{NS}
Crude protein (%)	63.59^a	68.84^{ab}	68.28^{ab}	71.38^{ab}	74.00	2.41*
Crude fibre (%)	42.69	45.36	48.30	47.61	49.61	4.63^{NS}
Ether extract (%)	74.52	74.87	71.01	74.86	74.43	2.64^{NS}
N2 Free extract (%)	83.05	86.43	86.70	83.55	83.96	2.33^{NS}

a,b, Means denoted by the different alphabetical are significantly different (P<0.05). NS- Not significantly different (P>0.05).

Table 5: Performance, cooking loss and cooking yield of broilers fed cornflakes waste based diets

Cornflakes waste level (%)	0	20	40	60	100	SEM
	T_1	T_2	T3	T4	T5	
Body weight at starter(g)	1033.33^a	1058.33^{ab}	1004.42^{ab}	1125.42^b	1014.44^a	78.5
Body weight at finisher(g)	2333.2	2177.78	2111.13	2277.78	2975.25	26.1
Cooking loss	46.69^{ab}	38.48^a	38.45a	44.28^a	50.00^b	2.84
Cooking yield	53.31^{ab}	61.52^b	61.53^b	55.72^b	50.00^a	2.86

a,b, means denoted by different alphabets in the same row are significantly (p< 0.05) different.

with tenderness, juiciness and flavour of lean or muscle structure. High quality meat is expected to have rigid structure, hence soft muscle may be as a result of high content of soft fat.

Conclusion: Cornflakes waste could be used as an energy source in broiler diet. Broilers fed the mixture of maize 80.0% or 40.0% along with 20.0 or 60.0% cornflakes waste had superior body weight at the starter phase. Broilers fed 100.0% cornflakes waste seemed to have a high body weight at the finisher phase the differences was not (p>0.05) significant. The best nutrient digestibility was also found in broilers fed 80.0 maize and 20.0 % cornflakes mixture similar to the one from birds fed 100.0% cornflakes waste as an energy source.

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