Nig. J. Anim. Prod. 2008, 35(1): 40 - 47

Effect of graded levels of pineapple (*Ananas comosus* L. Meer) crush waste on the performance, carcass yield and blood parameters of broiler chicken

Lamidi*, A. W., Fanimo A. O. Eruvbetine, D. and Biobaku, W. O.
College of Animal Science and Livestock Production, University of Agriculture, Abeokuta, Nigeria.

- **Corresponding author Address:** Department of Agricultural Education, Federal College of Education (Technical), Akoka, Lagos, Nigeria.

Abstract

A 56 – day feeding trial was conducted to evaluate pineapple crush waste (PCW) as dietary fibre source in broiler diets. Five straight diets were formulated to contain the PCW at dietary levels of 0%, 2.5%, 5.0%, 7.5% and 10.0% as replacement for wheat offal. One hundred and fifty (150), day-old "Anak 2000" broiler chicks were randomly allotted to the 5 diets containing three replicates per treatment with 10 chicks per replicate in a completely randomized design (CRD). The final body weight, daily weight, daily feed intake and daily protein intake were generally higher in the birds fed diet 2 (2.5% PCW). There were significant ($P < 0.05$) differences in daily feed intake and daily protein intake between the group on diet 1 and the other groups, while daily weight gain, feed conversion ratio and protein efficiency ratio were statistically the same ($P > 0.05$) across the treatments. Digestible crude fibre values significantly ($P < 0.05$) decreased with increasing levels of PCW in the diets while the other digestibility percentages were comparable ($P > 0.05$) in all dietary treatments. Values for the hematological parameters and blood serum chemistry did not deviate ($P > 0.05$) statistically from established normal values for chicken. However, liver weights significantly increased ($P < 0.05$) across the dietary treatments while other organs observed did not differ significantly ($P > 0.05$) in weight across the treatments. Cost per kg feed decreased as the level of PCW inclusion in the diets increased while the cost per kg weight gain showed that birds fed on diet 4 (7.5% PCW) were the most economical to produce. The results suggest that PCW could replace wheat offal in broiler diet up to 10.0% as a dietary fibre source without any deleterious effect.

Keywords: Pineapple waste, performance, carcass yield, blood parameters,broilers.

Introduction

The search for alternative feed ingredients for livestock feeding especially non-ruminants has continued to attract the attention of researchers especially in the developing nations of the world. The unprecedented increase in the cost of conventional ingredients (e.g. maize) used in compounding livestock feeds has necessitated intensive investigations into the use of agricultural and agro-industrial by-products, which are regarded as non-conventional feed sources (Hamzat and Babatunde, 2001).

The use of wheat offal as a major dietary fibre source in most parts of poultry producing areas of Nigeria has pushed up its price, thereby necessitating a search for a cheaper and locally available alternative such as pineapple crush waste (PCW). PCW is the waste generated from the pineapple cannery industry. Ucheagwu (1985) estimated that about 1000 ha of land is cropped with pineapple (*Ananas comosus* L. Meer) in Nigeria with smooth cayene as the most predominant variety. Yield of 80 – 100 tonnes / ha have been recorded on managed plots (Adeyemi and Ogazi, 1987). The wastes coming out from the canning process can be as high as 350kg/tonne of fresh fruits (Estanove, 1982). The use of industrial by-products from kola, mango, cocoa, plantain and cashew to feed livestock and especially poultry abound in literature (Sobamiwa, 1994; Ikurior and Akem, 1998), but information is lacking on the suitability of PCW as a poultry feedstuff. The present research effort is an attempt to explore this neglected by-product as a feedstuff for feeding broiler chicken.

Materials and Methods

Test Ingredient and diets

The PCW used for this trial was collected wet from CHI (Nig.) Ltd in Lagos, Nigeria. They were transported in used poultry feed bags to the experimental site for sun drying. They were weighed, manually pressed (by piling heavy weights for 6 hours) to facilitate drying, and spread on concrete slabs for drying. The drying took 10 days under intense sunshine. The dried samples (95.75% DM) were then bagged and stored.

Proximate analysis of the PCW was conducted according to AOAC (1990) to determine the percent crude protein, crude fibre, total ash and ether extract (Table 1). The PCW so prepared was used to formulate straight diets for broiler chicks at 0%, 2.5%, 5.0%, 7.5% and 10.0% inclusion levels respectively (Table 2).

Table 1: Proximate composition of PCW (% dry matter)

Component	%
Dry matter	95. 75
Crude protein	9. 13
Crude fibre	23. 83
Ether extract	1. 12
Ash	4. 53
Nitrogen free extract	57. 14

Animal and Management

A total of 150 unsexed day-old broiler chicks of commercial broiler strain (Anak 2000) were randomly allotted to fifteen replicate groups of ten chicks each. Three groups were assigned to each of the five dietary treatments. The experiment was arranged in a completely randomized design with PCW inclusion as the only source of variation. The experimental birds (10 per replicate) were kept in a 1.0m x 1.5m open-sided house. Heat was supplied during the brooding stage using 100 watts electric bulbs. Management procedures including vaccination were uniform for all the birds. Experimental diets and water were provided *ad libitum*. Weekly feed intake and body weight were measured. Other parameters were calculated from the feed intake and body weights.

Metabolic trial

This was carried out at 8th week of the experiment in specially designed metabolic cages equipped with separate feeders and watering troughs. For the metabolic trial, two birds were randomly selected from each of the three replicates and housed together in a compartment. A four-day acclimatization period was allowed prior to a three-day feacal collection period. Total droppings voided from each replicate group were weighed and recorded. Wet faecal samples were

Table 2: Composition of experimental diets (%)

	Replacement level of PCW				
Ingredient	**0%**	**2.5%**	**5.0%**	**7.5%**	**10.0%**
Maize	47.50	47.50	47.50	47.50	47.50
Full fat Soya bean	25.00	25.00	25.00	25:00	25.00
Wheat offal	15.50	13.00	10.50	8.00	5.50
PCW[1]	0.00	2.50	5.00	7.50	10.00
Blood meal	5.00	5.00	5.00	5.00	5.00
Fish meal	2.50	2.50	2.50	2.50	2.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.00	1.00	1.00	1.00	1.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin/Mineral premix[2]	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	21.59	21.43	21.27	21.10	20.94
Metabolizable energy (KCal/kg)	2864	2869	2874	2881	2886
Crude fibre (%)	4.19	4.53	4.88	5.23	5.57
Calcium (%)	1.64	1.64	1.64	1.63	1.63
Phosphorus (%)	0.99	0.96	0.93	0.90	0.87
Methionine (%)	0.37	0.36	0.36	0.35	0.35
Lysine (%)	1.22	1.20	1.18	1.16	1.14
Energy: Protein Ratio	132.66	133.90	135.15	136.42	137.78
Determined Analysis					
Crude protein (%)	22.96	22.53	22.30	22.09	21.87
Crude fibre (%)	5.50	5.64	5.90	6.01	6.50
Ether extract (%)	7.63	7.44	8.39	7.89	7.19
Ash (%)	8.14	9.15	10.73	8.30	12.53
Dry matter (%)	92.50	93.00	93.30	92.80	92.80

1. PCW = Pineapple crush waste
2. Premix contained the following: (Univit. 15 Roche) 1500 I.U., Vit. A, 1500 I.U., Vit. D, 3000 I.U., Vit. E, 3.0g, Vit. K, 2.5g, Vit. B_2, 0.3g, Vit. B_6, 8.0mg, Vit. B_{12}, 8.0g, Nicotinic acid, 3.0g, Ca-Pantothenate, 5.0mg, Fe, 10.00g, Al, 0.2g, Cu, 3.5mg, Zn, 0.15mg, I, 0.02g, Co, 0.01g, Se.

oven-dried at 65°C for 36 hours and dry matter content determined. Dried droppings from the same replicates were then thoroughly pooled and ground. Proximate composition of feed and droppings were determined using the methods of A.O.A.C. (1990).

Blood collection

Blood samples were collected separately from 3 birds per treatment group in specimen bottles with and without EDTA for plasma and serum analysis respectively. Packed cell volume (PCV), Haemoglobin concentration (Hb), red blood cell (RBC), white blood cell (WBC), total serum protein, albumin, globulin and creatinine were analyzed using the procedure described by Costab Health Centre, Diagnostic Laboratory, Haematology section (1987).

Carcass evaluation

At the end of the feeding trial, 2 birds were randomly selected from each replicate pen, starved for 10 hours, weighed, slaughtered and dressed. Dressed, carcass weights and relative

Table 3: Effect of PCW on performance and nutrient utilization

Parameters	Replacement level of PCW					
	0%	**2.5%**	**5.0%**	**7.5%**	**10.0%**	**±SEM**
Initial body weight (g/bird)	40.00	40.00	40.00	40.00	40.00	0.00
Final body weight (g/bird)	2144.64	2220.37	2132.37	2170.37	1989.29	31.50
Daily weight gain (g/bird)	37.53	38.93	37.44	38.04	34.85	0.56
Daily feed intake (g/bird)	92.59^{ab}	97.35^{a}	93.05^{ab}	97.16^{a}	89.36^{b}	1.05
Feed: Gain	2.47	2.50	2.49	2.56	2.57	0.02
Daily protein intake (g/bird)	21.26^{a}	21.93^{a}	20.75^{ab}	21.46^{a}	19.54^{b}	0.27
Protein Efficiency Ratio	1.76	1.77	1.80	1.77	1.78	0.01
Mortality (%)	6.67	10.00	10.00	10.00	10.00	0.67
Dry matter digestibility	65.68	68.66	75.00	69.92	75.89	1.86
Crude Protein retention	74.95	74.46	79.65	75.58	80.27	1.33
Digestible ether extract	79.53	80.67	88.50	84.64	87.63	1.27
Digestible crude fibre	17.02^{a}	13.58^{ab}	12.28^{ab}	5.89^{b}	6.99^{b}	1.44
Digestible Nitrogen free extract	78.21	78.78	83.00	80.93	83.02	1.17

a. b: Means within the same row with different superscripts differ significantly (P< 0.05).

cut-up parts and organ weights were also recorded. Feed cost per bird was calculated by taking the total cost of all the ingredients that constituted the diets, which were consumed by each bird in each of the dietary treatments, and the value divided by the body weight gain of the bird.

Statistical analysis

All data generated from the study were subjected to analysis of variance and significant means separated using Duncan's Multiple Range Test as outlined by Steel and Torrie (1980).

Results and Discussion

The pineapple crush waste (PCW) used in this experiment contained 23.83% crude fibre, 9.13% crude protein, 1.12% fat, 4.53% ash and 57.14 NFE. This is an indication that PCW is a good source of dietary fibre but low in crude protein; it is also uniquely low in fat and could serve as energy diluent when compounding a low fat diet for poultry.

Inconsistent growth response was observed in terms of daily weight gain, feed conversion ratio and protein efficiency ratio (Table 3). This suggested that higher inclusion of PCW did not enhance (P > 0.05) these performance indices. However, feed and protein intakes were significantly (P < 0.05) better in birds fed diets 2 (2.5% PCW) and 4 (7.5% PCW) than diet 5 (10.0% PCW). These observations could be attributed to direct relationship between final body weight and feed and protein intakes. Increasing levels of PCW in the diets insignificantly (P > 0.05) depressed feed conversion ratio. The value of 2.47 obtained for birds fed the control diet was numerically better (P > 0.05) than the other diets. In the study, it was generally observed that efficiency of feed utilization declines with increasing level of PCW inclusion in the diets. This occurrence may be due to the high fibre content (23.53%) in PCW, which invariably limits utilization by simple stomached animal, like broilers. The significantly (P < 0.05) superior values recorded for protein intake in birds fed diets 1, 2 and 4 translate to increased (P > 0.05) body weights, a view already established by Idowu *et al.* (2003). The values (Table 3) recorded for all digestibility percentages, with the exception of crude fibre were not significant (P > 0.05) across the treatments. The utilization of crude fibre in the experimental diets varied significantly (P < 0.05) in favour of the control diet (0% PCW). The results therefore suggest a decreasing (P < 0.05) trend across the treatments. This is because the test ingredient is highly fibrous (23.83% crude fibre) and could be indigestible at high inclusion level in the diet. Increasing levels of PCW insignificantly and inconsistently (P > 0.05) improved crude protein retention. The trend in these results suggests a somewhat improved (P > 0.05) protein retention with increasing level of dietary PCW inclusion. The abrasive nature of fibre and greater volume of ingesta had been implicated by Hedge *et al.* (1978) to cause an increase in metabolic nitrogen retention.

The data (table 4) obtained for all blood parameters measured were not significant (P > 0.05) among the treatment groups. It was generally observed that the least values were recorded for birds on diet 2 (2.5% PCW) in virtually all the parameters investigated. This is an indication that the test ingredient (PCW) had a mild effect on the blood parameters. The implication of reduced (P > 0.05) total blood protein (39.33 mg/dl) in diet 2 is reduction in total protein in an animal (Allison, 1955) and by extension a decline in the efficiency of protein utilization.

Variability among birds fed the different dietary treatments for dressing percentage was not significant (P > 0.05). The values (Table 5) obtained fall within the range of 69.8% and 72.6% reported by Longe (1986), and 73.9% by Bolu and Balogun (2003) for broilers. Except for liver and large intestine, there was no evidence to suggest that the inclusion of the test material (PCW) had any negative impact on the organs weights. Significant (P < 0.05) increase in liver weight was observed between those birds fed the control diet and diet 3, as well as those between diets 4 and 5, and diets 3 and 4. The reason for these increases is unclear because pineapple had not been reported to contain any allelochemical apart from bromelin, a proteolytic enzyme. The results of gizzard weight, which favoured (P > 0.05) birds on diet 2 did not reflect the expected impact of the texture (coarse) of

Table 4: Blood parameters of birds fed the experimental diets.

	Replacement Level of PCW					
Parameters	**0%**	**2.5%**	**5.0%**	**7.5%**	**10.0%**	**± SEM**
Packed Cell Volume (%)	27.00	24.67	27.33	30.00	29.33	0.74
Haemoglobin (g / dl)	9.03	8.27	9.23	10.00	9.80	0.24
Red Blood Cell (ml / mm^3)	3.03	2.77	3.13	3.40	3.27	0.09
White Blood Cell (no/ mm^3)	5600.00	5866.70	5933.00	5867.00	5666.70	63.10
Total Protein (mg / dl)	43.00	39.33	43.33	47.67	46.67	1.15
Albumin (mg / dl)	26.00	23.33	26.00	28.67	28.00	0.71
Globulin (mg / dl)	17.00	16.00	17.33	19.00	18.67	0.46
Albumin / globulin ratio	1.53	1.46	1.50	1.51	1.50	0.02
Creatinine (mg / dl)	1.10	0.97	1.07	1.23	1.10	0.04
Glucose (mg / dl)	51.67	46.67	51.67	58.33	55.00	1.53

Table 5: Carcass characteristics of birds fed the experimental diets

	Replacement Level of PCW					
Parameters	**0%**	**2. 5%**	**5.0%**	**7.5%**	**10. 0%**	**±SEM**
Live Weight (kg/bird)	2.15	2.30	2.18	2.13	2.08	0.04
Dressing Percentage (%)	72.60	73.98	71.57	69.49	70.12	1.24
Head (%)	3.09	2.66	3.00	3.33	3.13	0.08
Back cavity (%)	18.24	18.42	17.95	16.81	16.47	0.51
Breast (%)	19.77	20.58	17.61	18.57	18.78	0.63
Thighs (%)	10.80	10.45	10.53	10.02	10.57	0.29
Drum sticks (%)	10.77	10.75	12.32	11.26	10.99	0.29
Wings (%)	9.14	7.97	8.63	8.89	8.83	0.17
Proventriculus (%)	0.49	0.50	0.48	0.50	0.51	0.02
Gizzard (%)	2.42	2.68	2.22	2.55	2.32	0.08
Heart (%)	0.40	0.50	0.48	0.46	0.45	0.02
Liver (%)	1.78^{b}	2.32^{ab}	2.61^{a}	1.92^{b}	2.70^{a}	0.13
Small intestine (%)	2.25	2.02	2.02	2.00	2.23	0.08
Caeca (%)	0.30	0.34	0.34	0.32	0.36	0.01
Large intestine (%)	0.26^{a}	0.19^{ab}	0.08^{c}	0.15^{bc}	0.11^{c}	0.02
Abdominal fat (%)	0.85	1.01	0.68	0.57	0.69	0.09
Small intestine (cm)	201.13	173.40	184.57	184.47	191.62	4.22
Caeca (cm)	44.90	43.67	39.27	38.77	43.03	1.49
Large intestine (cm)	10.23^{a}	9.50^{ab}	7.40^{bc}	6.73^{c}	10.80^{a}	0.52

a, b, c : Means within the same row with different superscripts differ significantly ($P< 0.05$).

PCW on the organ. Ordinarily, an increase in weight of this organ should occur with increased PCW (a highly coarse feedstuff) inclusion in the diets. This unusual observation could be attributed to the moderate level (10% maximum) of PCW in the experimental diets. The values recorded for abdominal fat were not significant ($P > 0.05$). It could be deduced from these results that higher inclusion of dietary PCW did not significantly ($P > 0.05$) increase the abdominal fat in broiler chickens. The uniquely low fat content (1.12%) of the PCW could be responsible for this observation.

Treatment 5 was the poorest in the economy of production (Table 6) by gaining 1 kilogrmme body weight with N98.70 while treatments 4 was the best as N95.38 was expended to produce the same quantity of body weight. However, there was no significant ($P > 0.05$) difference across the experimental treatments. As it turned out, the successful reduction in the cost of feed per kilogramme was translated into least cost of production per kg gain. This result agreed with the findings of Ekenyen (2002) who reported that reducing feed cost/kg was only justifiable when production results is comparable with the standard (control.)

Conclusion

The results of this study indicated that the test ingredient (PCW), which hitherto constituted environmental nuisance, could be used as a dietary fibre source. As a preliminary finding, broiler chickens could tolerate up to 10.0% PCW in their diets without any deleterious effect.

Table 6: Economics of feed conversion of broilers fed the Experimental Diets.

	Replacement Level of PCW				
Parameters	**0%**	**2.5%**	**5. 0%**	**7. 5%**	**10.00%**
Initial body weight (g/ bird)	40.00	40.00	40.00	40.00	40.00
Final body weight gain (g/bird)	2144.64	2220.37	2132.37	2170.37	1989.29
Total weight gain (g/ bird)	2104.64	2180.37	2092.37	2130.37	1949.29
Total feed consumed (kg / bird)	5.19	5.45	5.21	5.25	5.00
Cost of feed/kg diet (₦)	39.33	39.05	38.88	38.70	38.53
Total cost of feed consumed/bird (₦)	204.10	212.82	202.54	203.18	192.63
Cost of feed /kg weight gain (₦)	97.11	97.62	96.60	95.38	98.70

References

Adeyemi, S.A. and Ogazi, P.O. (1987): Export potential of fruits grown in Nigeria.
Raw Materials update. *A bi-annual publication of the Raw Materials and Development Council.* 1 : 14 – 15.

A.O.A.C. (1990). Association of Official Analytical Chemists. Official method of analysis. 15th ed. Washington D.C.

Bolu, S.A. and Balogun, O.O. (2003): Effects of graded levels of Iron fortified locally produced natural vitamin premix on the performance and carcass characteristics of broilers. *Nig. J.Anim. Prod.* 30 (2): 192 – 196.

Costab Health Centre (1987): Determination of packed cell volume, haemoglobin, total protein. Diagnostic laboratory, haematology section, Unpublished.

Ekenyen, B.U. (2002). Economic viability of raising weaner rabbits on Guinea grass (*Panicum maximum*) supplemented with graded levels of poultry grower ration. Nig. Society for Animal Production. 17 – 21st March, 202, Akure pp 180 – 181

Esfanove, P. (1982). Utilization de l'ananas. Document IRFA non public.

Hamzat, R.A. and Babatunde, B.B. (2001) Performance characteristics of broiler finisher fed *Cola nitida* pod husk based diet. *Moor J. of Agric. Res.* 2, (2): 153 – 158.

Hedge, S.M., Rolls, B.A.., Turkey, A and Coates, M.E. (1978) The effect on chicks dietary fibre from different sources: a growth factor in wheat bran. *Brit. Journal Nutri.* 40:63 – 69.

Idowu, O.M.O., Eruvbetine, D., Oduguwa, O.O., Bamgbose A.M. and Abiola, S.S. (2003). Response of finishing broiler chickens fed three energy/ protein combinations at fixed E:P ratio. *Nig. J. Anim. Prod.* 30 (2): 185 – 191

Ikurior, S.A. and Akem, J.D. (1998). Replacing maize with cassava root meal or its mixture with brewers' yeast slurry in rabbits diets. *Nig. J. Anim. Prod.* 25 (1) 31 – 35.

Longe, O. (1986). Replacement value of biscuit waste for maize in broiler diets. *Nig. J. Anim. Prod.* 13: 70 – 78.

Sobamiwa, O. (1994). Use of cocoa pod husk in feeds. A particular reference to the Nigerian Situation. 11th Int. Cocoa Res. Conf. Yammussoukro, Ivory Coast.

Steel, R.G.D. and Torrie, J.H. (1980). Principles and procedures of Statistics. A Biometrical Approach. 2nd Edition. Mc. Graw Hill Book Co. New York.

Ucheagwu, A.C. (1985). Pineapple production in Nigeria Proc. The Nat. Fruit Prod. Workshop, Ibadan, Nigeria, March 14th – 16th. pp 71 – 76.

(Received 28th Feb. 2006; Accepted 6th Sept., 2007).