Utilization of hatchery waste meal in cassava products based broiler finisher diets

Agunbiade J. A.[1], *Adeyemi O. A.[1], Salau K. O.[1] and Taiwo A. A.[2]
[1]Department of Animal Production, Faculty of Agricultural Production and Renewable Resources. Olabisi Onabanjo University, Yewa Campus. PMB 0012 Ayetoro, Ogun State.
[2]Department of Livestock Improvement Programme. Institute of Agricultural Research and Training, PMB 5029 Moor Plantation, Ibadan, Oyo State.

*Correspondence Author. Email: olajideadeyemi@yahoo.com

Abstract

The trial reported herein investigated the use of hatchery waste meal as a replacement for fishmeal in a cassava products-based broiler finisher diet. One hundred and twenty five (125) four-week old broilers were randomly allotted to five iso-energetic and iso-nitrogenous experimental diets such that each dietary treatment was replicated five times with five birds /replicate. All the diets contained whole cassava root meal (WCRM) as source of energy with soybean meal (SBM) and cassava leaf meal (CLM) (plant protein sources) supplying 50% and 25% of the total dietary protein respectively. The experimental treatment consists of fishmeal (FM) and hatchery waste meal (HWM) as animal protein sources supplying the remaining 25% of the total dietary protein. Additionally, In Diet 1 (FM and HWM supplied 100.0 and 0% of dietary animal protein respectively), diet 2 (FM and HWM supplied 75.00 and 25.00% of dietary animal protein respectively), diet 3 (FM and HWM supplied 50.00 and 50.00% of dietary animal protein respectively), diet 4 (FM and HWM supplied 25.00% and 75.00% of dietary animal protein respectively) while in diet 5 (FM and HWM supplied 0 and 100.00% of dietary animal protein respectively).. The diets were fed over a five-week period. Average daily feed intake was not significantly affected by dietary treatments; weight gain and feed conversion ratio were however significantly affected (P< 0.05) by dietary treatment. Protein retention was significantly influenced (P<0.05) by dietary treatments. Blood biochemical indices showed that hatchery waste meal was well utilized by finishing broilers. All hatchery waste meal based diets compared very favorably with the control, with Diet 3 appearing as the best with respect to performance indices and protein retention. In conclusion, the results of this experiment indicated that hatchery waste meal holds promise as a replacement for fishmeal in cassava root-cassava leaf-based diets.

Keywords : Broilers performance. Hatchery waste meal. Fishmeal. Cassava. Replacement. Blood biochemical indices.

Introduction

Cassava is a crop with a lot of potential as a feed ingredient however it has low protein content. Furthermore, its protein is of poor quality compared with that of cereal grain. Agunbiade *et al* (2001) explained that to utilize cassava in replacing cereals in diets for non-ruminants, it is necessary to balance for protein deficiencies, which are sometimes expensive. Experiments with broilers (Agunbiade *et al.*, 2002; 2004b) and pigs (Agunbiade *et al.*, *2004a*; Agunbiade and Susenbeth, 2006) have indicated that part of the protein deficiency of cassava root meal can be rectified cheaply using cassava leaves. The reason for this is that the conventional protein sources such as fishmeal, soybean meal and groundnut cake are too expensive for such generous use that will overcome the deficiencies of cassava. Hence the need to search inwards for alternatives to the very important and expensive fishmeal which is an animal protein source that is rich in lysine and sulphur-containing amino acids. One of our recent reports (Agunbiade *et al* 2007), indicated that maggot meal could be utilized along with cassava root and cassava leaf meal in laying hens diets with

satisfactory performance. Another animal protein source that could be harnessed in these series of studies is hatchery waste meal. Hatchery waste meal is the result of broken and/or unhatched eggs at facilities designed to produce young chicks for stocking poultry production houses. The wastes consist of unhatched chicks, membranes, embryonic fluids and eggshell. This study investigated the effects of replacing fishmeal with hatchery waste meal in cassava products- based diets on broiler performance.

Materials and methods

Test materials

Fresh cassava roots (12 months old, variety TMS30572) were obtained from Teaching and Research Farm of the University, washed to dislodge all adhering soil and particles, sliced to thin chips and sun dried to a moisture content <10% and milled to pass through a 2mm sieve. Cassava leaves were harvested without petiole wilted overnight, sun dried for three days and milled. Hatchery waste was collected from a reputable hatchery, cooked for 40minutes, drained and allowed to cool. Efforts were made to remove as much shell as possible prior to size reduction and sun drying. Collection from different batches were pooled together, milled and bagged

Experimental diets

All the diets contained whole cassava root meal (WCRM) as source of energy with soybean meal (SBM) and cassava leaf meal (CLM) (plant protein sources) supplying 50% and 25% of the total dietary protein respectively (Table 1). The experimental treatment consisted of fish meal (FM) and hatchery waste meal (HWM) as animal protein sources supplying the remaining 25% of the total dietary protein. In Diet 1(FM and HWM supplied 100.0 and 0% of dietary animal protein respectively), diet 2 (FM and HWM supplied 75.00 and 25.00% of dietary animal protein respectively), diet 3 (FM and HWM supplied 50.00 and 50.00% of dietary animal protein respectively), diet 4 (FM and HWM supplied 25.00% and 75.00% of dietary animal protein respectively) while in diet 5 (FM and HWM supplied 0 and 100.00% of dietary animal protein respectively).

Experimental Management of birds and data collection

One hundred and twenty five (125), unsexed four-week old Cobb broilers of a commercial strain were selected from a larger flock. The birds were distributed into five groups of 25 birds after balancing for weights and sexes. Each group was replicated to 5 of five chicks in each. The chicks of each replicate were housed at random in wire floored battery cages having provision of feeders, waterers and faecal trays in an open-sided poultry house. Each replicate cage was randomly allotted to the five dietary treatments. Uniform management and health practices were followed for all the chicks. Feeds and water were provided *ad libitum* during the experimental period that lasted for thirty-five days. The same diet was given to the birds throughout the experimental period. Weight changes and replicate-wise feed intakes were recorded at weekly intervals. Feed conversion ratio was calculated as feed intake per weight gain.

Serum bio-chemical analysis

Midway through the feeding trial, about 3 ml of blood was collected from brachial vein from three birds in each replicate and analysed for total serum protein, serum urea, SGOT and SGPT using standard methods as described by Baker and Silverton (1985).

Metabolic Studies

At the end of the 4th week of feeding experimental diets, a digestibility trial was

Table1: Composition (%) of broiler finisher diets containing Hatchery Waste Meal.

	1 100 % FM	2 75% FM 25% HWM	3 50% FM 50% HWM	4 25% FM 75% HWM	5 100% HWM
Cassava root meal	35.36	32.91	30.58	28.77	25.81
Cassava Leaf meal	25.00	25.00	25.00	25.00	25.00
Soybean meal	25.00	25.00	25.00	25.00	25.00
Fish meal	7.64	5.73	3.82	1.91	0.00
Hatchery waste meal	0.00	4.30	8.60	12.90	17.20
Palm Oil	3.00	3.40	3.80	4.20	4.60
Oyster Shell	1.55	1.53	1.54	1.55	1.56
Bone meal	1.00	0.80	0.60	0.40	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Determined Analysis(%)					
[1]Dry matter	91.05	91.40	91.25	89.35	89.10
[1]Crude protein (%)	22.51	23.30	23.75	22.55	23.18
[1]Ether extract	5.08	5.64	6.90	7.15	8.98
[1]Crude fibre	4.12	5.50	5.92	4.10	5.45
[2]Ca (%)	1.35	1.29	1.25	1.35	1.29
[2]P(%)	0.69	0.63	0.65	0.69	0.63

*Provide the following per kg. of feed:
Vit A, 10000000 iu; Vit D_3, 2,000000 iu; Vit B_1, 0.75g; Vit B_2, 5g;Nicotinic acid, 25g; Calcium pantothenate, 12.5g; Vit B_{12}, 0.015g; Vit K_3, 2.5g; Vit E, 25g; Biotin, 0.05g; Folic acid, 1mg; Choline chloride, 250g; Cobalt, 0.4g; Copper, 8g; Manganese, 64g; Iron, 32g; Zn ,40g; Iodine, 0.8g; Flavomycin, 100g; Spranycin, 5g; DL-Methionine 50g; Selenium, 0.16g; L-Lysine, 120g; BHT 5g.
[1] = determined analysis [2]= calculated analysis

Table 2: Proximate composition of test ingredients (%)

	CRM	CLM	HWM
Dry matter	92.00	94.67	91.02
Crude protein	2.15	22.50	36.85
Ether extract	1.02	5.88	15.21
Crude fibre	5.62	12.22	2.16
Ash	3.05	8.01	26.85
NFE	80.16	45.89	9.95

carried out. During the digestibility trial, data on the daily feed consumption were collected. The droppings were collected daily on previously weighed aluminium foil using the total collection method as described by Cullison (1982). Such daily droppings from each replicate were weighed fresh and oven dried at 70°C for 72hours. The oven dried samples were ground and kept for analysis and subsequent determination of apparent retention and digestibility of nutrients.

Carcass Evaluation

At the end of the metabolic studies, two birds in each replicate were weighed, tagged and slaughtered by cutting the vena cava. The head, crop and shank were removed and the carcass eviscerated for calculation of dressing percentage.

The different parts: thigh, drumstick, neck, wing, breast-cut and back cut were weighed. In addition, organs including the pancreas, heart, liver, kidney, gizzard, spleen and the lungs were excised out and weighed.

Chemical and analytical procedure

(a).- Proximate analysis

The proximate analysis of the experimental diets and droppings were carried out using the method of AOAC (1995)

(b).- Statistical analysis

All data were subjected to analysis of variance as applicable to a completely randomized design using the method of Steel and Torrie 1980. Significant differences were partitioned using the Duncan's new multiple range test (Duncan, 1955)

Results and discussion

Proximate composition of test ingredients

The proximate compositions of the test ingredients {Cassava root meal (CRM), Cassava leaf meal (CLM) and Hatchery waste meal (HWM)} are shown in Table 2.

The proximate composition of hatchery waste meal indicated crude protein value of 36.85%, ether extract value of 15.21% and ash content of 26.85%. The cassava root meal used in this study had proximate values within the ranges of 1.5-3.5% CP, 1.3-7.7%CF, 0.8-3.2%EE and 1.6-4.1% ash as reported by Oyenuga (1968), Smith (1992), Oguntimehin(1992), Aduku (1995) and Adeyemi *et al* (2007) for Nigerian cassava varieties.

Performance of finishing broilers fed diets containing Hatchery Waste Meal

The performance of finishing broilers on diets containing graded levels of HWM is shown in Table 3. Average daily feed intake was not significantly affected by dietary treatment ($P>0.05$). Dietary treatment however significantly ($P<0.05$) influenced daily weight gain and the feed: gain ratio. Birds on diets containing HWM gained significantly more weight than the birds on the control diet. The trend of weight gain is Diet 3> Diet 2> Diet 4. > Diet 5> Diet 1. Broilers on Diet 5 in which HWM completely replaced fish meal exhibited a 12.4% additional average daily weight gain above those of birds on diet 1 (control) with 100% fish meal. While birds on diet 3 which gave the best daily weight gain had 21.96% more weight than the control.

It took significantly ($P>0.05$) less feed to gain a unit weight by broilers on Diet 3 (50% FM: 50% HWM) compared to the other diets. Dietary treatments containing HWM were significantly more efficiently utilised than the control diet. Gohl (1970) reported that performance was not found to be different when hatchery by-product meal was incorporated into diets at the 8 and 16% level replacing soybean meal and meat and bone meal and fed to layers,

The digestibility of dry matter was not significantly affected by dietary treatment. Protein retention was however influenced

Table 3: Growth performances and nutrient retention of finishing broilers fed diets containing Hatchery Waste Meal

	1 100 % FM	2 75% FM 25% HWM	3 50% FM 50% HWM	4 25%F M75% HWM	5 100% HWM	SEM
Weight gain (g/bird/day)	30.60^{c}	35.27^{b}	37.32^{a}	35.18^{b}	34.38^{b}	0.32*
Feed intake (g/bird/day)	103.87	105.66	103.00	104.19	103.73	4.62^{NS}
Feed: Gain	3.39^{a}	3.00^{bc}	2.76^{d}	2.96^{c}	3.02^{b}	0.01*
Dry matter Digestibility (%)	84.74	84.97	85.00	84.98	84.85	0.44
Protein Retention (%)	77.45^{d}	80.44^{b}	79.46^{c}	81.20^{a}	78.35^{d}	0.36*

*Means within the same row bearing different superscripts are significantly different ($p<0.05$). ; NS= Means within the same row with no superscripts are not significantly different ($p>0.05$).

by dietary treatment. Protein retention was significantly higher on diet 3 compared to the other diets while birds on Diet 1 and Diet 5 had similar protein retention.

Effect of dietary treatment on carcass characteristics

The result of the carcass analysis of broilers fed diets containing graded level of hatchery waste meal in replacement for fish meal is shown in Table 4.

The result of the carcass analysis showed that dressed weight, dressing percentage, breast cut, thigh weight and drumstick were significantly influenced by dietary treatment ($P<0.05$). Dressed weight was highest for bird on diet 3(50:50, FM: HWM) while the value of the other treatment were not significantly different. Dressing percentage was however similar for birds on the control diets and those on diet 3(50:50) while the least dressing percentage was obtained from birds on diet 5 100%HWM.

Dressed weight is more important to poultry meat consumer than the live weight. This eventually will reflect on the dressing percentage. This perhaps explains the higher dressing percentage obtained on birds fed diet 3. According to Agunbiade (2000), thigh, drumstick and breast are prime cuts of chicken, which gives a picture of the carcass meatiness and eventually revenue yield. In this study, dietary treatment did not affect organ weight, wings, neck, shanks, head and fat values ($P>0.05$).

Effects of dietary treatments on blood and blood biochemical indices

The influence of dietary treatment on blood and blood biochemical indices are indicated in Table 5. Dietary level of HWM had no significant effect ($P>0.05$) on packed cell volume (PCV), Red and White blood cell counts.

Blood biochemical picture did not indicate any significant difference that can be attributed to dietary treatments. The use of biochemical indices as a pointer to conditions that may not be readily noticed by performance indices cannot be over-emphasized. Plane of nutrition is known to affect the values of Serum Glutamate Oxaloacetate Transaminase (SGOT) and Serum Glutamate Pyruvate Transaminase

Table 4: Influence of dietary treatments on cut-up parts and relative organ weights (% Dressed Weight)

	1 100 % FM	2 75%FM 25% HWM	3 50%FM 50% HWM	4 25%FM 75% HWM	5 100% HWM	SEM
Liveweight (g)	1700.00	1912.50	1925.00	1875.00	1925.00	98^{NS}
Dressed weight	1137.50^{b}	1192.50^{b}	1300.00^{a}	1197.50^{b}	1182.50^{b}	118*
Dressing %	66.91^{a}	62.35^{c}	67.52^{a}	64.10^{b}	61.43^{c}	0.68*
Breast cut	15.01^{c}	16.18^{ab}	16.25^{a}	15.92^{b}	16.01^{b}	0.37*
Thigh	11.72^{ab}	11.50^{b}	12.25^{a}	10.67^{c}	10.00^{d}	0.17*
Drumstick	10.45^{b}	10.50^{b}	11.50^{b}	10.36^{b}	9.30^{b}	0.15*
Shank	4.18	3.58	4.73	4.15	4.23	0.09^{NS}
Wings	7.96	7.38	7.95	7.20	8.00	0.11^{NS}
Head	2.67	2.65	2.70	2.55	2.77	0.02^{NS}
Neck	4.91	4.28	4.80	4.38	4.14	0.10^{NS}
Empty Gizzard	2.16	2.00	1.98	1.84	1.94	0.03^{NS}
Liver	1.82	1.83	1.80	1.77	1.73	0.11^{NS}
Abdominal fat	0.51	0.57	0.52	0.59	0.51	0.02^{NS}

*Means within the same row bearing different superscripts are significantly different ($p<0.05$). ; NS= Means within the same row with no superscripts are not significantly different ($p>0.05$).

Table 5: Haematological and Blood biochemical indices of finishing broilers fed diets containing hatchery waste meal

	1 100 % FM	2 75%FM 25%HWM	3 50%FM 50% HWM	4 25%F M 75% HWM	5 100% HWM	SEM
Packed cell volume (%)	27.25	27.29	27.56	27.33	27.22	0.21^{NS}
Red blood cell count 10^{6} mm^{-3}	3.51	3.48	3.45	3.50	3.46	0.03^{NS}
White blood cell 10^{3} mm^{-3}	31.66	31.61	31.64	31.68	31.65	0.25^{NS}
Haemoglobin (Hb)	8.94	8.89	8.90	8.87	8.85	0.045^{NS}
Total serum Protein (mg/dl)	68.42	68.71	68.55	68.30	68.14	2.35^{NS}
Urea (mg/dl)	10.42	10.38	10.40	10.39	10.35	2.50^{NS}
Serum Glutamate Oxaloacetate transaminase (SGOT, mg/dl)	1.55	1.53	1.54	1.55	1.56	0.25^{NS}
Serum Glutamate Pyruvate transaminase (SGPT, mg/dl)	1.28	1.26	1.26	1.25	1.26	0.01^{NS}

NS –Not significantly different

(SGPT). Their values are normally very low except in cases when the nutritional plane is very low or the presence of a toxic factor, which may affect the liver. Haemotocrits, erythrocytes and haemoglobin are known to be positively correlated with protein quality and protein level (Adeyemi *et al*., 2001). Adeyemi *et al*. (2008) observed that decreased red blood cell counts are usually associated with low quality feed and protein deficiency. The figures obtained for red blood cells and packed cell volume fall within the normal range as established by Ross *et al*,(1978).

The generally low and insignificant blood urea values obtained in this trial is an indication that the amino acid profile of the test diets is balanced. Kumpta and Harper (1961) explained that an amino acid imbalance would result in an increase in blood urea concentration. Urea level is known to be a function of protein quality; as high urea level is an indication of low protein quality. Ranjhan (2001) explained that in a diet that is deficient in essential amino acid the amino acid present will be deaminated and hence result in an increase in the excretion of urea.

Hematological constituents usually reflect on the physiological responsiveness of the animal to its internal or external environment this serves as a veritable tool for monitoring animal health. The present result of hematological indices is indicative that HWM had no negative effect on internal physiology of the birds.

Blood biochemical picture did not indicate any difference that can be attributed to dietary treatments. The use of biochemical indices as a pointer to conditions that may not be readily noticed by performance indices cannot be over emphasized. Plane of nutrition is known to affect the values of Serum Glutamate Oxaloacetate Transaminase (SGOT) and Serum Glutamate Pyruvate Transaminase (SGPT). Their values are normally very low except in cases when the nutritional plane is very low or the presence of a toxic factor, which may affect the liver.

Based on the results of this trial, it appears that hatchery waste meal is a suitable alternative to fishmeal as the dietary animal protein source in a cassava root, cassava leaf meal based broiler finisher diet.

References

Adeyemi O. A., Balogun M. O. and Fasina O. E. 2001. Response of finishing broilers to graded levels of boiled Jatropha seeds. *Indian. J. Anim. Sci.* 71(8):800-803.

Adeyemi O.A., Eruvbetine D., Oguntona T., Dipeolu M. A., Agunbiade J. A. and Olubanjo O. O. 2007. *In-vitro* changes in the proximate composition, hydrocyanic acid content and mineral profile of whole cassava root meal by rumen filtrate fermentation. In: *Pathway to sustainable agriculture and rural economic development in Nigeria.(Essays in Honour of Bamidele O. Durojaiye).* Edited by O.O.Olubanjo. St. Paul's Publishing House Ibadan. Pp 137-156.

Adeyemi O. A., Eruvbetine D., Oguntona T., Dipeolu M. A. and Agunbiade J. A., 2008. Feeding broiler chicken with diets containing whole cassava root meal fermented with rumen filtrate. *Archivos de Zootechnia* 57:247-258.

Aduku A. O. 1995. Feed composition and nutrient composition alimentaire. Dept. of Animal Science. Ahmadu Bello University, Zaria. 8pp

Agunbiade J. A., 2000. Utilisation of two varieties of fullfat and simulated soybeans in meal and pelleted diets by broiler chickens. *Polym. Int.* 49: 1529-

1537.

Agunbiade J. A. Adeyemi O. A., Fasina O. E. and Bagbe S. A. 2001. Fortifications of cassava peel meal in a balanced diet for rabbits. *Nig. J. Anim. Prod*, 26:167-173.

Agunbiade J. A., Adeyemi O. A, Ashiru O. M., Awojobi H. A., Taiwo A.A., OKE D. B and Adekunmisi A. A., 2007. Replacement of fishmeal with maggot meal in cassava based layers diet. *J.Poult Sci.*, 44:278-282.

Agunbiade J. A., Adeyemi O. A., Adepoju O. A. & Lawal O. A., 2002. The use of whole cassava meal and leaf meal in broiler diets. *Trop. J. Anim. Sci.*5:161-173.

Agunbiade J. A., Sussenbeth A. and Sudekum K. H., 2004a. Comparative nutritive value of cassava leaf meal, soybeans, fish meal and casein in diets for growing pigs. *J. Anim. Phys. and Anim. Nutr.*, 88:30-38.

Agunbiade J. A., Tolorunju B. O. and Awojobi H. A., 2004b. Shrimp waste meal supplementation of cassava products based diet fed to broiler chickens. *Nig. J. Anim. Prod.* 31: 182-188.

Agunbiade J. A. and Sussenbeth A., 2006. Protein utilisation and bioavailability of lysine in cassava leaf meal, fish meal, fullfat and extruded soybean meals in diets for growing pigs. *ASSET, Series A*, 5: 21-30.

AOAC 1995. *Official method of analysis* (18th., ed). Association of Official Analytical Chemists, Washington D.C.

Baker FJ and SILVERTON R. E., 1985. Introduction to medical laboratory technology, 6th edition. Butterworth, England.

Duncan D. B., 1955. Multiple range and multiple F test. ***Biometrics*** **11:1-24.**

Gohl B. L., 1970, Animal feed from local products and by-products in the British Caribbean. Rome, FAO. AGA/Misc/70/25

Kumpta U. S. and Harper A. E., 1961. Aminno acid imbalance. VII. Effect of dietary addition of amino acids on feed intake and blood urea concentration of rats fed low protein diet containing fibrin. *J. Nutr.* 73:139-147.

Oguntimehin G. B., 1992. Processing cassava for animal feeds. In: *Cassava as livestock feed in Africa* (S.K. Hahn, L. Reynolds and G.N. Egbunike, editors). Proc. IITA/ILCA/UI Workshop on potential utilisation of cassava as livestock feed in Africa. Pp39-53.

Oyenuga V. A., 1968. *Nigerian feeds and feeding stuff.* University of Ibadan Press, Ibadan, Nigeria.

Ranjhan S. K., 2001. Animal nutrition in the tropics, 5th edition. Vikas Publishing House. PVT Limited, New Delhi, India. 576pp.

Ross J. G., Christie G., Halliday W. G. and Morley J., 1978. Haematological and blood chemistry comparison values for clinical pathology in poultry. *Veterinary Record* 102: 29-31.

Smith O. B., 1992. A review of ruminant response to cassava based diets. In: *Cassava as livestock feed in Africa* (S.K. Hahn, L. Reynolds and G.N. Egbunike, editors). Proc. IITA/ILCA/UI workshop.

Steel R. G. D. and Torrie J. H., 1980. Principles and procedures of statistics. McGraw Hill Book Co. Inc., New York.

Received: 08/09/2010
Accepted: 08/05/2011