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Replacement of Fish Meal with Maggot Meal in Cassava-based Layers' Diets

Jubril A. Agunbiade[1], Olajide A. Adeyemi[1], Olukemi M. Ashiru[1], Hakeem A. Awojobi[1], Abiodun A. Taiwo[2], Daniel B. Oke[1] and Adebola A. Adekunmisi[1]

[1] Department of Animal Production, Olabisi Onabanjo University, Yewa Campus, P.M.B 012 Ayetoro, Ogun State, Nigeria

[2] Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B. 5029, Moor Plantation, Ibadan, Oyo State, Nigeria

The trial reported herein investigated the use of maggot meal as a replacement for fish meal in a cassava products-based layers diet. Old laying hens (50 weeks in lay) made up of two hybrids (Isa Brown and Black Nera) were randomly allotted to five iso-energetic and iso-nitrogenous experimental diets such that each dietary treatment was replicated three times with two birds/replicate. All the diets contained whole cassava root meal (WCRM, 390.2–424.6 g/kg) 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 fish meal (FM) and maggot meal (MM) as animal protein sources supplying the remaining 25% of the total dietary protein. Additionally, in diet 1 (FM and MM supplied 25.0 and 0% of dietary animal protein respectively), diet 2 (FM and MM supplied 18.75 and 6.25% of dietary animal protein respectively), diet 3 (FM and MM supplied 12.50 and 12.50% of dietary animal protein respectively), diet 4 (FM and MM supplied 6.25% and 18.75% of dietary animal protein respectively) while in diet 5 (FM and MM supplied 0 and 25.0% of dietary animal protein respectively). The diets were fed over an eight-week period. Average daily feed intake, weight gain and feed conversion ratio were not significantly affected ($P>0.05$) by dietary treatment although breed of laying bird significantly affected ($P<0.05$) these indices. Hen-day egg production was significantly influenced ($P<0.05$) by dietary treatments. Of all egg quality characteristics investigated, only shell thickness and shell weight were significantly ($P<0.05$) affected by dietary treatment and breed. In conclusion, the results of this experiment indicated that maggot meal holds promise as a replacement for fish meal in cassava root-cassava leaf- based diets as it could replace 50% of the dietary animal protein supplied by fish meal without deleterious effects on egg production and shell strength.

Key words: cassava, egg quality, fish meal, maggot-meal, layers

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Introduction

The ever-rising cost and chronic shortages of traditional feed resources have hampered attempts at expanding the poultry industry in Nigeria. Seasonal and unreliable rainfall, marginal soil fertility and subsistence farming leave nations with erratic supplies of locally grown cereals and protein feeds (Ravindran, 1993; Baker, 1995). In the last one and half decades, many research efforts were directed on the search for alternative energy sources for poultry (Eruvbetine and Afolami, 1992; Eruvbetine *et al.,* 2003). One of such alternatives is cassava. The potentials of cassava as a feed ingredient not withstanding, this commodity is much lower in protein content. Furthermore, its protein is of poor quality

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Correspondence: Dr. O.A. Adeyemi, Department of Animal Production, Olabisi Onabanjo University, Yewa Campus, P.M.B 012 Ayetoro, Ogun State, Nigeria. (E-mail: olajideadeyemi@yahoo.com)

compared with that of cereal grain. When utilized in replacing cereals in diets for non-ruminants, it becomes imperative to balance for protein deficiencies, which are sometimes expensive (Agunbiade *et al.,* 2001). Experiments with broilers (Agunbiade *et al.,* 2002; 2004b) and pigs (Agunbiade *et al.,* 2004 a; Agunbiade and Susenbeth, 2006) have indicated that part of this 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 fish meal, 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 fish meal which is an animal protein source that is rich in lysine and sulphur-containing amino acids. For example, the expensive fish meal would be replaceable by the locally available maggot meal, which has a similar amino acid profile (Atteh and Ologbenla, 1993).

The objective of this study is to investigate the effects of replacing fish meal with maggot meal in cassava products- based diets on egg production and quality attributes of two hybrids of laying birds.

Materials and Methods

Whole cassava root, washed to dislodge adhering soil particles was sliced to thin chips and sun-dried to a moisture content of 10% and milled to pass through a 2 mm sieve. Cassava leaves harvested without the petiole, wilted overnight and sun-dried was also milled. Maggot was collected from poultry waste, thoroughly washed using tap water and dried on a concrete platform to moisture content of 9%. The maggots were milled and bagged. Other materials were purchased from reputable feed depot nearby. Sixty laying hens made up of thirty Isa Brown and thirty Nera Black layers were selected from a larger flock previously on a standard commercial diet. The birds were randomly allotted to the five experimental diets such that each diet was fed to 6 birds of each breed. The birds were 50 weeks in lay at the commencement of the feeding trial. Each dietary treatment was replicated three times with four birds/replicate. Feeds and water were provided *ad libitum* during the experimental period that lasted for eight weeks. The same diet was given to the birds throughout the experimental period.

Data collected are feed intake, weight gain, feed conversion ratio, hen-day production and egg quality indices as well as nutrient retention. The oven-dried samples of diets and excreta were analyzed for residual moisture and other proximate fractions using the methods of AOAC (1995). All data collected were subjected to statistical analysis appropriate for a 2×5 factorial design using Minitab Analytical computer package (Minitab Inc., 1999). Significant means were separated using Duncan's multiple range test (Duncan, 1955).

Results and Discussion

Table 2 shows the performance of layers fed experimental diets (Table 1) containing whole cassava root meal, cassava leaf meal, fish meal and maggot meal. Feed intake was not affected by dietary treatments ($P > 0.05$). Breed of layer also had no effect on feed intake ($P > 0.05$).

All birds irrespective of treatment or breed exhibited non-significant weight losses ($P > 0.05$). Feed conversion efficiency, measured as kg feed/kg egg, was equally not affected by increasing the dietary level of maggot meal. The results obtained here is at variance with the report of Atteh and Adeyoyin (1993) that increasing the concentration of maggot meal at the expense of fish meal in layers' diet resulted in a significant reduction in feed intake and a consequent reduction in weight gain. Akpodiete *et al.* (1998) however, indicated that incremental replacement of fish meal by maggot meal up to 100% of the diet for 36-weeks old Nera laying birds had no effect on feed intake, weight gain and efficiency of conversion. These two sets of workers used corn based diets as opposed to cassava root meal-based diets used in this study. Atteh and Adeyoyin (1993) explained the reduction in feed intake as being related to the high energy content of maggot relative to fish meal thus reducing feed intake. This was not, however, the case in the present study. Though there were no significant differences ($P > 0.05$) in the feed conversion ratio of the birds across treatment and breed, birds with 50: 50 replacement had a better conversion ratio than the others and Isa Brown had a better conversion ratio than Nera Black indicating that birds on diet 3 needs only 2.78 kg of feed to attain 1 kg of eggs compared with others requiring over 3 kg of feed. Birds on diet 3 had the lowest conversion ratio numerically, depict-

Table 1. **Composition of experimental diets fed to Laying hens (g/kg)**

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Ingredients	50% SBM 25% CLM 25% FM 0% MM	50% SBM 25% CLM 18.75% FM 6.25% MM	50% SBM 25% CLM 12.5% FM 12.5% MM	50% SBM 25% CLM 6.25% FM 18.75% MM	50% SBM 25% CLM 0% FM 25% MM
Cassavaroot meal	424.6	416.7	407.4	398.8	390.2
Fish meal	60.0	44.3	30.0	15.0	0.0
Maggot meal	0.0	23.6	47.2	70.8	94.4
+FixedIngredients	515.4	515.4	515.4	515.4	515.4
Calculated Analysis					
Crude protein (g/kg)	180.9	180.0	180.0	179.8	179.4
Crude fibre (g/kg)	92.9	93.8	94.6	95.5	96.4
Calcium (%)	4.21	4.12	4.00	3.94	3.80
Phosphorus (%)	0.56	0.54	0.51	0.48	0.45
ME (kcal/kg)	2486.59	2483.61	2480.89	2478.04	2477.19

+Fixed Ingredients (g/kg): Soybean Meal (SBM) 193.2; Cassava Leaf Meal (CLM) 193.2; Veg. oil 25.0; Premix 2.5; Oyster shell 72.0; Bone meal 24.0; Lysine 1.0; Methionine 1.5; Salt 3.0.

FM=Fish Meal, MM=Maggot Meal, (%)=Percentage protein in the diet contributed by specific feed ingredient.

Table 2. **Performance of layers on diet containing graded levels of maggot meal protein**

	Diets					SEM	Breeds		SEM	Diet×breeds interaction
	1	2	3	4	5		1	2		
Av. Feed intake (g/bird/day)	124.00	123.17	124.00	124.67	125.00	0.64^{NS}	124.60	123.73	0.40^{NS}	NS
Wt. gain (g/bird/day)	−2.83	−2.68	−2.46	−0.89	−1.64	0.86^{NS}	−2.20	−1.99	0.55^{NS}	NS
FCR (feed/kg egg)	3.04	3.20	2.78	3.05	3.83	0.35^{NS}	3.24	3.12	0.22^{NS}	NS
Hen-day production (%)	67.43^{ab}	62.95^{ab}	70.83^{ab}	63.68^{ab}	55.22^{b}	4.68	63.93	64.11	2.96^{NS}	NS
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS

* Means within the same row bearing different superscripts (^{a,b}) are significantly different ($P<0.05$).

NS=Means within the same row with no superscripts are not significantly different ($P>0.05$).

ing the greatest efficiency of converting feed to eggs.

The hen-day production was significantly ($P<0.05$) affected by the dietary treatments. Diet 3 had the highest hen-day production and this could be as a result of complementary effect of the amino acid profile of maggot meal and fish meal. Birds on diet 5 had the lowest hen-day production. Parshikova *et al.* (1981) reported an increase in egg yield when housefly larvae replaced fish meal in the diet of hens. Ernst *et al.* (1984) has also replaced meat meal with maggot meal in the diet of laying hens and observed a 3.9% increase in egg yield. There were no breed effects on hen-day egg production ($P>0.05$) of the birds.

No mortality was recorded during the feeding trial ($P>0.05$). Earlier studies had shown that the risk of disease transfer is low if maggots are treated properly before incorporation into livestock diets. Koo *et al.* (1980) observed no pathological signs associated with feeding maggot-based diets to chicks. In the study carried out by Atteh and Oyedeji (1990), no disease symptoms or mortality was observed when maggot replaced groundnut cake in broiler diets. The results obtained in this trial show that Diet 3 (in which 50% of the dietary animal protein was contributed each by FM and MM) elicited the best response in terms of weight gain, feed intake, feed conversion ratio and hen-day production.

Table 3 shows the mean values and standard error of means of internal and external egg qualities of layers fed the different experimental diets. There were no significant effects ($P>0.05$) of the diets supplemented with maggot meal over the control diet (Diet 1) on egg shape index, yolk index and yolk colour. Lack of significance in the yolk colour of birds in all experimental diets is thought to be as a result of the fact that the birds were given the same level of cassava leaf meal and palm oil in their diets. These two ingredients are known to have strong

Table 3. **Effects of Dietary Treatments and Breeds on Egg Quality**

	Diets (D)					SEM	Breeds (B)		SEM	D×B
	1	2	3	4	5		1	2		
Egg weight (g)	61.37	64.43	63.42	65.78	64.80	1.52[NS]	64.13	63.79	0.96[NS]	NS
Egg shape index	0.78	0.78	0.77	0.79	0.77	0.01[NS]	0.78	0.78	0.01[NS]	NS
Yolk index	0.60	0.56	0.61	0.61	0.60	0.02[NS]	0.56	0.61	0.01[NS]	NS
Yolk colour	4.83	4.33	4.67	4.67	5.00	0.29[NS]	4.87	4.53	0.18[NS]	NS
Shell thickness (mm)	0.397[a]	0.37[ab]	0.352[b]	0.363[ab]	0.373[ab]	0.23*	0.35[b]	0.39[a]	0.01*	NS
Shell weight (g)	8.150[a]	8.033[ab]	8.083[a]	8.005[ab]	7.300[b]	0.23*	7.51[b]	8.34[a]	0.14*	NS
Haugh unit (%)	60.25	60.41	69.86	65.67	67.19	4.26[NS]	65.15	64.21	2.70[NS]	NS

* Means within the same row bearing different superscripts ([a, b]) are significantly different ($P<0.05$).
NS=means within the same row with no superscripts are not significantly different ($P>0.05$).

pigmenting properties (Atteh, 2002). Egg weight and haugh unit were not significantly affected by dietary treatments ($P>0.05$). Breeds of layer similarly had no significant effect on egg weight and haugh unit ($P>0.05$).

The shell thickness and shell weight were significantly ($P<0.05$) affected by the dietary treatments and breeds. Eggs from birds on 100% fish meal had the highest shell thickness value and at the same time the highest shell weight value. Birds on diets containing maggot meal exhibited linear ($P<0.05$) decrease in shell thickness and shell weight respectively. The reason for the reduction in shell thickness with increasing concentration of maggot meal is thought to be as a result of the lower calcium content compared to fish meal.

From the results of the experiment, it appears that maggot meal holds promise as a replacement for fish meal in a cassava root cassava leaf based diet if used up to 50% of the dietary animal protein supplied by fish meal without deleterious effects on egg production. The use of maggot meal in replacement for fish meal may require additional amount of calcium sources for laying hens.

References

Agunbiade JA, Adeyemi OA, Fasina OE and Bagbe SA. Fortification of cassava peel meal in a balanced diet for rabbits. Nigerian Journal of Animal Production, 28: 167–173. 2001.

Agunbiade JA, Adeyemi OA, Adepoju OA and Lawal OA. The use of whole cassava meal and leaf meal in broiler diets. Tropical. Journal of Animal Sciences 5: 161–173. 2002.

Agunbiade JA, Susenbeth A and Sudekum KH. Comparative nutritive value of cassava leaf meal, soyabeans, fish meal and casein in diets for growing pigs. Journal of Animal Physioogy and Animal Nutrition, 88: 30–38. 2004a.

Agunbiade JA, Tolorunju BO and Awojobi HA. Shrimp waste meal supplementation of cassava products based diet fed to broiler chickens. Nigerian Journal of Animal Production, 31: 182–188. 2004b.

Agunbiade JA and Susenbeth A. Protein utilisation and bioavalability of lysine in cassava leaf meal, fish meal, full-fat and extracted soyabean meals in diets for growing pigs. Agricultural Science, Sciences, Environment and Technology, Series A., 5: 21–30. 2006.

Akpodiete OS, Ologhobo AD and Onifade AA. Maggot meal as a substitute for fish meal in laying chicken diet. Ghana Journal of Agricultural Science, 31: 137–142. 1998.

AOAC. Official Methods of Analysis (18th ed). Association of Official Analytical Chemists, Washington D.C. 1995.

Atteh JO. Principles and practice of livestock feed manufacturing. pp.1–217, Adlek Printers, Ilorin, Nigeria. 2002.

Atteh JO and Adeyoyin DD. Effects of replacing dietary fish meal with maggots on performance and nutrient retention of laying hens. Nigerian Journal of Animal Production, 20: 50–55. 1993.

Atteh JO and Ologbenla S. Replacement of fish meal with maggots in broilers' diet. Nigerian Journal of Animal Production, 20: 44–49. 1993.

Atteh JO and Oyedeji JO. The replacement value of maggots for groundnut cake in broiler diet. Centre Point, 2: 15–19. 1990.

Baker MM. Who is responsible for the world food shortage? Executive Intelligence Review, 22: 1–5. 1995.

Duncan DB. Multiple range and multiple F tests. Biometrics, 11: 1–42. 1955.

Ernst I, Vagapou R, Pozdeeva T, Zhemehuzhina A and Zvereva E. A high protein feed from poultry manure. Nutrition Abstracts and Reviews, 54: 445. 1984.

Eruvbetine D and Afolami CA. Economic evaluation of cassava (*Manihot.esculenta*) as a feed ingredient for broilers. In: Proceedings World's Poultry Congress. Amsterdam, Netherlands, 3: 151–155. 1992.

Eruvbetine D, Tajudeen ID, Adeosun AT and Olojede AA. Cassava (*M.esculenta*) leaf and tuber concentrate in diets for broiler chickens. Bioresource Technology, 86: 277–281. 2003.

Koo SI, Currin TA, Johnson MG, King EW and Turk DE.

The Nutritional value and microbial content of dried face fly pupae (*Musca autumnalis* (De Geer) when fed to chicks. Poultry Science, 59: 2514–2518. 1980.

Minitab Inc. Minitab Data Analysis Software, Release 7.1 Standard Version. 1999.

Parshikova OA, Chaphinskaya KN, Molchanova NV and Romasko UN. Metabolism and productivity of hens given diets with ground housefly larvae. Nutrition. Abstacts and Reviews, 52: 361. 1981.

Ravindra A. Cassava leaves as Animal Feed: Potentials and limitations. Journal of Science Food and Agriculture, 61: 141–150. 1993.