

Replacement value of hatchery waste meal for fish meal in the diet of laying Japanese Quail (*Coturnix coturnix japonica*)

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Abstract

A 10 week feeding trial was carried out to evaluate the replacement value of hatchery wastes for fish meal in the diet of laying Japanese quail (*Coturnix coturnix japonica*). 108 female Japanese quails (36 per treatment) were randomly allocated into 3 dietary treatments A, B and C which are fish meal (FM), whole hatchery waste meal (WHWM) and shellless hatchery waste meal (SHWM) based diets respectively in a completely randomized design. The performance showed that feed intake was not significantly ($p > 0.05$) influenced by the diets while weight gain was ($p < 0.05$) influenced. Diet B (WHWM) was significantly higher ($p < 0.05$) in hen day production. Feed efficiency and cost per kg of feed were highest ($p < 0.05$) in diet A (FM). The egg quality parameters were not adversely affected by the replacement with hatchery waste. Diet B (WHWM) had the highest values for egg weight, shell thickness and % shell. The values gotten for hematology parameters showed that RBC, PCV and Hb were reduced ($p < 0.05$) in WHWM while birds on FM had superior ($p < 0.05$) WBC and monocytes values. It was concluded that hatchery waste meal can successfully replace fish meal with an enhanced value on egg quality at a reduced cost without any adverse effect on hematology parameters in laying Japanese quail diets.

Keywords

Hatchery wastes
Fish meal
Japanese quail
Hematology

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Introduction

The expansion of Nigeria's commercial poultry production has great potential in improving animal protein status of the Nigerian populace (Adeniji, 2005) which as being previously reported to be low (Akinwumi *et al.*, 2011). Japanese quail (*Coturnix coturnix japonica*) has proven to be the quickest and the cheapest substitute to the expensive sources of animal food protein (Ayanwale and Arziki, 2003) in Nigeria. They are prolific, required less feed and life expectancy is relatively longer (2-2.5 years) than domestic fowl (Smith, 2001). They mature in about 6 weeks and are usually in full egg production by 50 days with hens laying up to 200-300 eggs in their first year of lay (Smith, 2001) and many studies showed that this species can easily adapt to commercial management conditions (Paulillo *et al.*, 2009). Haruna *et al.* (1997) showed quail meat and eggs to be renowned for their high quality protein, high biological value and low caloric content, making it a choice product for hypertension- prone individuals.

Hatchery waste meal is rich in protein but has not received enough attention in terms of utilization in Nigeria. When compared to other by products of animal origin, it hold promise as a replacement for fish meal (Agunbiade *et al.*, 2007). Hatchery waste can be processed into useful feed by cooking, drying

and grinding. This present study is aimed at evaluating the replacement value of hatchery waste meal for fish meal in the diet of laying Japanese quail.

Materials and Methods

Location of the experiment

The experiment was carried out at the Center for Quail Research, Teaching and Research farm, Ladoko Akintola University of Technology, Ogbomoso, Oyo State, south west Nigeria

Preparation of test ingredient

Hatchery waste was obtained from Nabest farm hatchery in Ogbomoso (a major hatchery in Ogbomoso metropolis). The collected hatchery wastes were separated into those with shells (containing fully or partially developed chicks) and those without shells. They were separately cooked for 30 mins, sundried for 5-6 days, with regular turning and spreading to avoid fungal growth, milled and bagged.

Management of experimental birds

108 female Japanese quails (32 days old) obtained from National Veterinary Research Institute VOM were used for this study. The birds (36 per treatment) were randomly allocated into 3 dietary treatments A, B and C (Table 1) and each diet replicated thrice.

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Table 1. Gross composition of experimental diets

Ingredients	Diet A (Fish meal)	Diet B (WHWM)	Diet C (SHWM)
Maize	50	50	44.58
Groundnut	28.0	29.03	28.47
Fishmeal(72%)	5	-	-
¹ WHWM	-	9.67	-
² SHWM	-	-	9.95
Palm kernel meal	11.75	11.75	11.75
Bone meal	3	3	3
Oyster shell	1.5	1.5	1.5
³ Premix (layer)	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total	100	100	100

¹-WHWM = whole hatchery waste meal, ²-SHWM = shellless hatchery waste meal

³-Premix supplied/kg diet: Vitamin A (15,000 I.U.), Vitamin D3 (3,000 I.U.), Vitamin E (20 I.U.), Vitamin K (25 mg), Thiamin (2 mg), Riboflavin (6 mg), Pyridoxine (4 mg), Niacin (40 mg), Cobalamin (0.02 mg), Pantothenic acid (910 mg), Folic acid (1.0 mg), Biotin (0.08 mg), Choline Chloride (0.05 g), Manganese (0.096 g), Zinc (0.06 g), Iron (0.024 g), Copper (0.006 g), Iodine (0.004 g), Selenium (0.024 g), Cobalt (0.02 mg), Antioxidant (0.125 g).

Diet A was the control diet with fish meal (**FM**) as sole animal protein source.

Diet B contained whole hatchery waste meal (**WHWM**) as sole animal protein source.

Diet C had Shellless hatchery waste meal (**SHWM**) as sole animal protein source.

The experimental diets and WHW and SHW were analyzed for proximate composition (AOAC, 1990). The birds were housed in special cage designed for them. The quails were weighed on the first day before the diets were administered. Feed and clean water were provided ad libitum and routine management practices such as cleaning, picking of eggs, administration of anti-stress among others were carried out on the birds. At the end of each experimental week, the weight of the quails were noted and recorded in order to record weight changes

Data collection

Data were collected on performance the following indices Feed intake: this was determined by subtracting the quantity of the leftover of feed from the total quantity supplied at the beginning weekly.

Body weight gain: This was determined as the difference in the body weight of birds recorded at the beginning of the experiment and the end.

Hen-day production: Egg production was recorded daily and pooled weekly to calculate Hen-day production.

$$\text{Hen-day production (\%)} = \frac{\text{Number of eggs produced}}{\text{Number of quails} \times \text{Number of days}} \times \frac{100}{1}$$

Egg quality parameters

All eggs collected during the last 2 days of each week were individually weighed using a sensitive scale and are used weekly to determine egg quality parameters throughout the 10 weeks experimental period. After weighing, each egg was broken around the equator carefully to keep the yolk intact. Albumin heights were measured with the help of calipers and the values obtained were used to calculate the Haugh unit values according to the formula outlined by

Haugh (1937) $HU = 100 \log (H + 7.57 - 1.7W^{0.37})$ where H is the observed albumen height in millimeter and W is the observed weight of egg in gramme.

Haematological parameters

The blood samples were collected in the morning of the last day of the experiment via the wing vein and transferred immediately into a set of sterile plastic bottles with anti-coagulant for haematological test. Packed Cell Volume (PCV), Red Blood Cell counts (RBC), White Blood Cells (WBC) and Haemoglobin (Hb) were determined as outlined by Schalm *et al.* (1975) and Kelly (1979) while MCH, MCV and MCHC were computed using appropriate formulae as described by Jain (1986).

Data analysis

All data obtained were subjected to analysis of variance according to Steel and Torrie (1980), Treatment means were separated by Duncan Multiple Range Test of the same package.

Results and Discussion

Proximate analysis (Table 2) showed that crude protein ranged from 23.40-24.31% while the ether extract ranged from 3.68-3.79 for all the diets. The highest value for crude fiber was in diet B however ash content for diet C was the highest (12.14%) followed closely by B (12.06%) while the least was found in diet A (11.72%). Variation also exist in the proximate composition of the test ingredients as WHW was highest in dry matter and ash content, SHW showed better values in other parameters Abiola *et al.* (2009) highlighted infertile egg, dead embryos and eggshells present in the processed HWM as factors responsible for such variations. The slightly lowered crude protein (CP) in WHWM based diet and WHW, could be linked to the presence of eggs shell which agreed with Ristic and Kormangos (1988) and Abiola *et al.* (2009) who reported that high egg shell in hatching waste reduced the crude protein content. However the values of CP in this study are low compared with other works by Rasool *et al.* (1999) and Abiola (1999) who reported 44.25% and 56.00%, respectively. Expectedly, both WHWM based diets and WHW had higher ash contents. Lilburn *et al.* (1997) stated that high ash and calcium contents of hatchery residue would warrant its inclusion in practical diets as a source of supplemental calcium while Driver *et al.* (2006) reported that carcass quality depends on the level of calcium and phosphorus fed to an animal.

The performance of Japanese quail fed hatchery waste meal as a replacement of fish meal is shown in Table 3. Average daily feed intake was not

Table 2. Proximate composition of experimental diets WHW and SHW

Determined composition	Diets			WHW	SHW
	A (FM)	B (WHWM)	C (SHWM)		
Moisture content	11.29	11.18	11.23	4.36	6.11
Dry matter	88.70	88.82	88.77	95.64	93.86
Crude protein	23.40	23.92	24.31	36.88	37.92
Ether extract	3.68	3.64	3.79	5.36	6.17
Crude fiber	3.53	3.64	3.57	-	-
Ash content	11.72	12.14	12.06	19.36	13.17
Nitrogen free extract	46.36	45.65	45.04	34.02	36.60

FM = Fish meal, WHWM = whole hatchery waste meal, SHWM = shellless hatchery waste meal, WHW = whole hatchery waste, SHW = shellless hatchery waste.

Table 3. Performance and egg quality parameters of laying Japanese quail fed hatchery waste meal (HWM) as a replacement for fish meal

Parameters	Diets			SEM
	A (FM)	B (WHWM)	C (SHWM)	
Feed intake (g/Quail/wk)	20.8	20.9	19.5	0.37
Live weight gain (g)	8.4 ^c	10.9 ^b	11.5 ^a	0.27
Hen day production	55.9 ^b	71.4 ^a	54.6 ^b	4.4
Feed efficiency (kg feed/kg egg)	5.5 ^a	4.1 ^b	5.4 ^a	0.37
Yolk colour	1	1	1	-
Egg weight (g)	9.3 ^b	10.2 ^a	9.6 ^b	0.22
Haugh unit	86.2	86.8	87.1	0.22
Yolk index	0.35	0.33	0.34	0.005
Shell thickness (mm)	0.18	0.19	0.18	0.003

^{a,b,c} Mean along the same row with different superscripts are significantly different ($P < 0.05$).

significantly ($p > 0.05$) affected by the dietary treatment, however weight gain was significantly ($p < 0.05$) influenced by the diets with quails on diet C (SHWM) having the highest (11.5 g) followed by diet B (WHWM) (10.9 g) This was in agreement with the findings of Agunbiade *et al.* (2007) that weight gain increases when hatchery waste meal completely replaces fish meal in broiler chicken. Rasool *et al.* (1999) also revealed that growth performance trial on broiler chicks gave better weight gain and feed efficiency on the ration containing 12% of hatchery waste meal than fish meal. Diet B (WHWM) was also significantly higher ($p < 0.05$) in Hen-day production than A and C which were however similar ($p > 0.05$). Feed efficiency was in favour of diet A (FM) with the highest value while the least was found in diet B. Both whole hatchery waste meal (WHWM) and shellless hatchery waste meal (SHWM) i.e diets B and C have a lower ($P < 0.05$) cost per kilogram of feed as compared with Fish meal (diet A). With these results, hatchery waste meal requires less cost to produce the diets and still give a good performance.

Data on egg quality parameters (Table 3) showed that birds on diet B have higher ($p < 0.05$) egg weight than birds on diets A and C. There were however, no significant differences ($p > 0.05$) for yolk colour, Haugh unit, yolk index and shell thickness among the treatments. The haugh unit values obtained in this study connotes freshness and standard quality of egg since it is above 72%. Shell thickness values revealed that eggs produced by hens fed by HWM are adequate. The WHWM was highest for egg weight and shell thickness which could be attributed to high content

Table 4. Blood parameters of laying Japanese quail fed HWM as a replacement for fish meal

Parameters	Diets			SEM
	A (FM)	B (WHWM)	C (SHWM)	
RBC ($\times 10^6/\mu$)	6.30 ^a	5.70 ^b	6.30 ^a	0.14
PCV (%)	37.70 ^a	33.70 ^b	36.70 ^a	0.98
Hb (g/100ml)	12.10 ^a	11.10 ^b	12.30 ^a	0.30
WBC ($\times 10^3/\mu$ l)	10,000 ^a	8,000 ^b	8,250 ^b	513.7
Lymphocytes (%)	25.00 ^c	26.00 ^b	27.70 ^a	0.64
Neutrophils (%)	66.70 ^a	67.00 ^a	64.70 ^b	0.59
Monocytes (%)	5.70 ^a	4.70 ^b	4.70 ^b	0.25
MCHC (%)	33.00	33.90	33.60	0.22
MCV (fl)	57.90	58.30	58.10	0.09

^{a,b,c} Mean along the same row with different superscripts are significantly different ($P < 0.05$).

of calcium sequel shells in the test ingredient used for the diet and could justify its (HWM) inclusion in practical diets as reported by Lilburn *et al.* (1997). This study supported the finding of Abiola and Onunkwor (2004) who earlier reported that complete replacement of fish meal with HWM in layer diet have no adverse effect on egg quality characteristics.

All the heamatological parameters were influenced ($p < 0.05$) with the dietary treatment except for MCHC and MCH (Table 4). Similar trend was observed in RBC, PCV and Hb diets with FM and SHWM were similar ($p > 0.05$) but significantly ($p < 0.05$) different to the birds fed WHWM. For White blood cell and monocytes, birds on diet fed with FM gave better ($p < 0.05$) values compared with those fed hatchery waste. Heamatological values are widely used to determine systemic relationship and physiological adaptations including the assessment of general health condition of animal (Kamal *et al.*, 2007). Deviation from normal values of most blood parameters indicates an abnormal situation in the animal's body. As indicated by the result of this study, the values obtained for the blood parameters although showed lower values compared with the birds fed FM but were still in a good range to enhance optimal performance form the laying Japanese quails.

Conclusion

This study showed that quails fed whole hatchery waste meal had higher hen day production, better feed efficiency, reduced cost and heavier egg weight than quails on SHWM. Generally, feed intake and egg quality indices showed that hatchery waste can successfully replace fish meal in the diet of laying Japanese quails.

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