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Internal and External Qualities of Quail (*Cortunix cortunix japonica*) Eggs Due To Enzyme Supplemented High or Low Fibre Diets

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Abstract

Four hundred and eight 9 weeks old laying quails were utilized in an 8 week experiment to evaluate the effects of Maxigrain® enzyme supplementation of sugarcane scrapping meal-based diets on internal and external qualities of Japanese quails (Coturnix coturnix japonica) eggs. Six diets tagged $T10_0$, $T10_{100}$, $T10_{200}$, $T15_0$, $T15_{100}$ *and* $T15_{200}$ *were formulated to be isonitrogenous (20%CP) and isocaloric (2900.92-2992.53Kcal/kg ME). Diets* $T10_0$, $T10_{100}$ *and* $T10_{200}$ *contained 10% crude fibre with 0, 100 and 200 ppm enzyme supplementation while* $T15_0$, $T15_{100}$ *and* $T10_{200}$ *contained 15% dietary crude fibre level with 0, 100 and 200 ppm enzyme inclusion such that* $T10_0$ *and* $T15_0$ *function as the control for* $T10_{100}$ *and* $T10_{200}$, *and* $T15_{100}$ *and* $T15_{200}$, *respectively. The birds were randomly allocated to the 6 dietary treatments at the rate of 2 male and 15 female quails per replicate. Each treatment was replicated 4 times in a 3 x 2 factorial arrangements. The results showed that enzyme supplementation did not significantly (P>0.05) affect egg weight, yolk height, dried eggshell weight, eggshell thickness, egg proportion, egg width, egg height, egg shape index, haugh unit and albumen height. The interactive effects of Maxigrain® enzyme supplementation and dietary fibre influenced significantly weight of dried eggshell only. The weights (3.14 vs. 3.29 vs.2.84 vs.2.83 vs.2.97 and 3.19 g/shell) of the dried eggshell were same for all the treatments except for birds fed the high fibre without enzyme which had the least weight. In view of the performance of the quails fed the high fibre-high enzyme supplemented diets, it is nutritionally safe to use 200 ppm Maxigrain® enzyme supplementation in high fibre materials like sugarcane scrapping meal-based diets without affecting the quality of the eggs.*

Keywords: *Layer quails, sugarcane scrapping meal, enzyme supplementation and egg qualities*

Introduction

Japanese quail are small-sized, hardy and prolific birds (Robbins, 1981) and lay their first eggs between the 5th and 6th week of age (Martins, 1987). The meat is lean and the egg is low in cholesterol (Schwartz and Allen, 1981) which is of public health importance. Day old quail chicks weigh between 6 and 9 grams each depending on the size of the eggs.

Maize, most often, constitutes the highest proportion of ingredient in diet formulation of any poultry ration (Agbede *et al.*, 2002). This high inclusion rate translates into high cost of feed because of the seasonality of maize production and competition for its use by man (Agbede *et al.,* 2002). This indicates the need to replace maize in poultry diets with non-conventional feeds to reduce feed cost and overall production cost. One of such alternative by-products is sugarcane scrappings which contains dry matter of about 87.6%, 3.2% crude protein, 12.7% crude fibre, 2.8% ether extract, 12.8% ash, 77.1% nitrogen-free extract and gross energy of about 2.84 Mcal/kg (Ayoade *et al.,* 2007); this suggests that it can be a good source of energy for animals. Augustine (2005) investigated the effect of replacement of maize with graded levels of sugarcane scraping meal (SCSM) on the performance and carcass characteristics of growing rabbits where SCSM replaced maize completely (100%) and observed that the rabbits gained weight in all the treatments throughout the period of study while the digestibility of various nutrients and dressing percentages were high. These are indications of good nutritive value of SCSM in rabbit's rations. Replacement of maize with SCSM reduced the production cost and could make rabbit available to the general public at lower cost, this is attributed to the fact that SCSM is very cheap compared to maize. Since body weight gain, and feed conversion ratio were similar among treatments and there was reduction in production cost and profit increased as a result of the inclusion of SCSM, the author concluded that SCSM could replaced up to 100% of the maize in the diets of grower rabbits without adverse effect on performance (Ayoade *et al.,* 2007).

Enzyme addition to monogastric animal feed reduces viscosity of ingesta in the intestine and shows a marked improvement on the various morphological effects of feeding fibrous materials (Hastings, 1946 and Allen *et al.,* 1997) therefore, strategies for ensuring adequate nutrition of animals must be based on optimizing overall agricultural and livestock productivity from available resources, improving existing technologies and integrating technology that employs multipurpose crops and animals, and recycling of crop residues and by –products as feeding stuffs for animals (Njwe, 1990).

Maxigrain® enzyme is a multi-enzyme compound of β-glucanase, xylanase, phytase, arabinoxylanase and a mixture of yeast and minerals produced by the Bio-organics Ltd. It originates from the bacteria *Aspergillus oryzae.* Esuga *et al.* (2008) reported in an experiment to investigate the effects of feeding graded levels of palm kernel meal (PKM) in broiler chicken diets supplemented with Maxigrain® enzyme and observed a significant (P<0.01) difference in protein, fat, NFE and metabolizable energy retention in birds fed the Maxigrain® treated diets than those on diets without Maxigrain®. The objective of this study is therefore; to evaluate the effect of replacing maize with sugarcane scraping meal supplemented with exogenous enzyme on internal and external qualities of quail eggs due to enzyme supplemented high or low fibre diets.

Materials and Methods

Study area

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu – Lafia Campus. Lafia is found in the Guinea Savanna zone of North Central Nigeria and is located on latitude 08^0 35'N and longitude 08^0 33' E. The mean maximum and minimum temperatures are 35. 06 and 20.16^{0}C, respectively while the mean relative humidity is 74 %. The annual rainfall is about 1168. 90mm (NIMET, 2008).

Sugarcane scrapping

Sugarcane scrapings was sourced from local sugarcane marketers within Lafia metropolis, sun-dried and milled to form the sugarcane scrapping meal (SCSM).

Preparation of experimental diets

Six experimental diets $T10_0$, $T10_{100}$, $T10_{200}$, $T15_{0,}$ $T15_{100}$ and $T15_{200}$ were compounded to be isonitrogenous (20% crude protein) and isocaloric (2900.92-2992.53Kcal/kg ME) with two levels of crude fibre. Three hundred and sixty 9-weeks old layer quails were randomly allocated to the treatments at rate of 60 birds per diet in an experiment that lasted for 8 weeks. Each treatment was replicated 4 times in a 3 x 2 factorial arrangement having 15 and 2 sexually matured female and male birds per replicate, respectively. Treatments $T10_0$, $T10_{100}$ and $T10_{200}$ contained 10% crude fibre (normal fibre level) with 0, 100and 200 ppm enzyme levels while treatments $T15_0$, $T15_{100}$ and $T15_{200}$ contained 15% crude fibre level (high fibre level) with 0, 100 and 200 ppm enzyme inclusion thus, treatments $T10_0$ and $T15_0$ served as the control for treatments $T10_{100}$ and $T10_{200}$ and $T15_{200}$ and $T15_{200}$, respectively. Other ingredients were included at the recommended levels to meet the nutrient requirements of the birds. The analyzed experimental diets for layer quails are presented in Table 2.

Experimental procedure

The birds were fed weighed amount of feed and provided clean drinking water *ad-libitum*. Lighting was provided using electricity bulbs during the night. The birds were administered vitamins/minerals orally and housed in deep litter pens constructed using wire mesh to allow for adequate ventilation. Other routine management practices were carried out throughout the experimental period conforming to the recommended practices (Haruna *et al.,* 1997).

Data collection

External characteristics of eggs

Two eggs per replicate were sampled at random for four consecutive days, each egg was assessed separately for egg weight, egg circumference/diameter and shell thickness. Individual egg weight was measured using a sensitive electronic balance. Egg width for each sampled egg was measured using a veneer caliper. The shells were dried and the shell thickness measured using a micrometer screw gauge.

Internal characteristics of eggs

These include the yolk width, yolk height, albumen width and albumen height which were determined using veneer caliper. The haugh unit was calculated using the formula of Haugh (1937): HU = log [H + 7.37 – 1.7W $^{0.37}$] 100 where: HU = haugh unit, H = Albumen height (mm), W = Weight of intact egg (g)

Statistical analysis

Data obtained were subjected to Two Way Analysis of Variance (ANOVA) and where significant differences (P>0.05) are observed, means were separated using Duncan's Multiple Range Test (Duncan, 1955) as described by Steel and Torrie (1980). The following statistical model was used: $Y_{ij}=\mu+A_i+B_j+(AB)_{ij}+€_{ijk}$, where $Y_{ij=}$ Individual observation, μ = general Mean, A_i = effect of Factor A, B_j = effect of Factor, $(AB)_{ij}$ = effect of interaction AB and $€_{ijk}$= experimental error.

Results and Discussion

Chemical composition of sugarcane scrapping

The chemical composition and mineral content of the test ingredient (sugarcane scrapping) is presented in Table 1.The calculated metabolizable energy from the proximate composition data using the formula described (Pauzenga, 1985) ME (kcal/kg) = 37x % CP x 81.1 x % EE + 35.5 x % NFE was 2970.45 which is close the 3432 kcal/kg ME for maize but higher than 2530 kcal/kg ME for groundnut cake as reported by Aduku (1993). The test ingredient contains low crude protein (8.25%), high crude fibre (36.48%) and low (3.36%) either extract. The dry matter was 90.67% while ash and nitrogen free extract were 9.98 and 67.40% respectively. This composition suggests that sugarcane scrapping, being a fibrous feed material, will require some level of processing or pre-digestion if must be fed to monogastric animals.

The calcium (2.99 to 3.14%) and phosphorus (1.61 to 1.71%) were adequate for quails in this age group and status (Musa *et al.*, 2007). The fibre fraction: neutral detergent fibre, acid detergent fibre, acid detergent lignin, hemicelluloses and cellulose were within the range of 39.96 - 56.38%, 19.21 - 38.21%, 5.92 - 6.37%, 18.17 - 24.90% and 13.12 - 25.84%, respectively.

Analyzed and energy composition of experimental diets

The chemical composition of the experimental diets for layer quail is presented in Table 2. The diets were formulated such that they were isonitrogenous (19.37 to 20.58% CP). The calculated metabolizable energy from the proximate composition data of the diets using the formula as described by Pauzenga (1985): ME (kcal/kg) = 37 x %

CP + 81.1 x % EE + 35.5 x % NFE, were isocaloric (2900.92-2992.53Kcal/kg ME) and are adequate for layer quails (Musa *et al*., 2007 and Bawa *et al*., 2012). The crude fibre values were 10% for diets $T10_0$, $T10_{100}$ and T_{200} while diets $T15_0$, $T15_{100}$ and $T15_{200}$ was about 15%. The values obtained for ether extract were less than 4% ranging from 3.68 to 3.91%, ash value was between 5.26 and 5.73%; the NFE was within the range of 59.07 and 61.32% while fibre fractions: NDF, ADF, ADL hemicellulose and cellulose were within the range of 49.65 and 55.69%. 27.29 and 33.96%, 10.67 and 17.15%, 20.80 and 23.36% and 16.62 and 18.59%, respectively. Calcium and phosphorus of the diets were calculated from NRC (1979) and were within the range of 2.99 and 3.14% and 1.61 and 1.71%, respectively. The levels of these minerals were adequate for layer quails in this age group (Musa *et al*., 2007).

Internal and external qualities of quail eggs

The effect of Maxigrain® enzyme supplementation or dietary fibre on internal and external qualities of quail eggs is shown in Table 3. The results showed that enzyme supplementation did not significantly (P>0.05) affect egg weight, yolk height, dried eggshell weight, eggshell thickness, egg proportion, egg width, egg height, egg shape index, haugh unit and albumen height. These results are consistent with the earlier findings of Odunsi *et al*. (2010) who reported a non-significant variation in the egg weight, egg shape index and egg shell thickness when protexin was added to quail diets. Edache *et al*. (2010) and Edwin (2002) also reported that addition of probiotics to diets did not affect egg weight. This result is however, contrary to the report on layer chickens, in which egg weight were higher on probiotics-supplemented diets than the control group (Edache *et al*., 2003a). The values reported in this study were higher than 1.30 - 1.42g/shell and 9.33-10.1g/egg for egg weight as reported by Odusnsi *et al*. (2010) and (2007), respectively.

All parameters measured such as egg weight, yolk height dried eggshell weight, egg shape index, height units and albumen height were not influenced by the dietary fibre in the diets except for egg width which reduced (14.00 and 13.08 mm/egg) significantly (P<0.05). The observation made from this study are in line with reports of Adeola and Olukosi (2008) who reported that feeds containing unconventional ingredients pose limitation to their use due to the presence of high fibre and anti-nutritional factors but enzyme supplementation leveled their performance. The values recorded in this study for egg weight were close to the 9.3-102g/egg as earlier reported by Akinwunmi *et al*. (2011), but higher values were recorded for shell thickness than those (0.18-0.19mm) reported by Odusnsi *et al*. (2007).

The interactive effects of Maxigrain® enzyme supplementation and dietary fibre (Table 4) influenced significantly weight of dried eggshell only. The weights (3.14 vs. 3.29 vs.2.84 vs.2.83 vs.2.97 and 3.19 g/shell) of the dried eggshell were same for all the treatments except for birds fed the high fibre without enzyme which had the least weight. The values recorded in this study were within the normal range as reported by Musa *et al*. (2008) and Odunsi *et al*. (2007). The eggshell thickness across the dietary treatment was relatively similar which showed that there are no difference in the amount of dietary calcium and phosphorous furnished by the diets.

Conclusions and Recommendations

The findings of this study revealed that sugarcane scrappings is high in energy content (about 2970.45 Kcal/kg ME) and can supports growth and production parameters of laying quails. Egg quality parameters were not influenced by enzyme but fibre and the interactive effects of enzyme and dietary fibre reduced egg width and dried eggshell weights respectively.

In view of the general performance by the quails, it is nutritionally safe to use the test ingredients without enzyme supplementation without affecting the qualities of the eggs. This will also reduce the cost of production.

Table 1. Proximate and energy composition of sugarcane scrapping

Nutrient	CP	EE	CF	Ash	DM	NFE	[a]Energy (Kcal/kgME)
%	8.25	3.36	36.48	9.98	90.67	67.40	2970.45

[a]Calculated from Pauzenga (1985: ME (kcal/kg) = 37 x % CP + 81.1 x % EE + 35.5 x % NFE

Table 2. Proximate and chemical composition of layer quails diets (%)

Nutrients	**$T10_0$**	**$T10_{100}$**	**$T10_{200}$**	**$T15_0$**	**$T15_{100}$**	**$T15_{200}$**
Dry matter	89.65	89.79	89.96	89.71	89.71	89.87
Crude protein	19.68	19.37	19.49	20.13	20.58	20.29
Crude fibre	10.75	10.26	10.19	10.84	10.96	10.70
Ether extract	3.86	3.79	3.68	3.91	3.83	3.89
Ash	5.67	5.26	5.43	5.73	5.56	5.47
Nitrogen-free extract	60.04	61.32	61.21	59.39	59.07	59.56
Neutral detergent fibre	49.65	51.06	55.69	52.69	54.12	53.86
Acid detergent fibre	27.29	29.87	33.96	31.89	32.67	31.95
Acid detergent lignin	10.67	11.28	17.15	13.38	15.86	14.79
Hemicellulose	23.36	21.19	21.73	20.80	21.45	21.91
Cellulose	16.62	18.59	16.81	18.51	16.81	17.16
[a]Calcium	3.14	3.14	3.14	2.99	2.99	2.99
[a]Phosphorus	1.71	1.71	1.71	1.61	1.61	1.61
[b]Energy (Kcal/kg ME)	2972.63	2900.92	2992.53	2970.26	2969.06	2978.46

[a]calculated from NRC (1979) , [b]calculated from Pauzenga (1985) : ME (kcal/kg) = 37 x % CP + 81.1 x % EE + 35.5 x % NFE.

Table 3. Effect of Maxigrain® enzyme supplementation or dietary fibre on internal and external qualities of quail eggs

Parameters	ENZYME TREATMENT MEANS					FIBRE TREATMENT MEANS			
	No Enzyme	100ppm Enzyme	200ppm Enzyme	SEM	LOS	Low fibre	High fibre	SEM	LOS
Egg weight (g/egg)	8.80	9.00	8.80	0.20	NS	8.97	8.76	0.16	NS
Yolk height (mm)	11.98	12.35	12.50	0.31	NS	12.18	12.37	0.25	NS
Dried eggshell weight (g/shell)	2.99	3.13	3.02	0.07	NS	3.09	3.00	0.06	NS
Eggshell thickness (mm/shell)	34.20	35.70	36.90	3.07	NS	33.20	38.00	2.50	NS
Egg proportion	34.02	34.73	35.51	1.22	NS	35.26	34.25	1.00	NS
Egg width (mm/egg)	13.63	14.01	12.99	1.22	NS	14.00^{a}	13.08^{b}	0.16	*
Egg height (mm/egg)	15.70	15.50	15.24	0.14	NS	15.57	15.37	0.12	NS
Egg shape index	1.03	1.11	1.17	0.08	NS	1.03	1.17	0.06	NS
Haugh unit (%)	71.40	78.60	69.20	5.82	NS	75.70	70.40	4.75	NS
Albumen height (mm/egg)	19.44	19.84	19.22	0.47	NS	19.56	19.45	0.38	NS

a, b- Means on the same row bearing different superscript differ significantly (P < 0.05), **NS**- No significant difference (P > 0.05), **LOS**- Level of significant difference

Table4. Effects of Maxigrain® enzyme supplementation and dietary fibre on internal and external qualities of quail eggs

Parameters	MAIN TREATMENT MEANS							
	T10	**$T10_{100}$**	**$T10_{200}$**	**T15**	**$T15_{100}$**	**$T15_{200}$**	**SEM**	**LOS**
Egg weight (g/egg)	8.84	9.14	8.94	8.76	8.86	8.67	0.28	NS
Yolk height (mm)	11.56	12.49	12.50	12.40	12.21	12.50	0.44	NS
Dried eggshell weight (g/shell)	3.14^{a}	3.29^{a}	2.84^{ab}	2.83^{ab}	2.97^{a}	3.19^{a}	0.10	*
Eggshell thickness (mm/shell)	32.00	34.50	33.00	36.50	36.90	40.80	4.34	NS
Egg proportion	35.66	36.00	34.11	32.39	33.46	36.92	1.73	NS
Egg width (mm/egg)	14.33	14.66	13.03	12.93	13.26	12.96	0.28	NS
Egg height (mm/egg)	15.98	15.51	15.21	15.43	15.48	15.26	0.20	NS
Egg shape index	0.87	1.06	1.17	1.19	1.16	1.17	0.11	NS
Haugh unit (%)	74.90	84.50	67.70	68.00	72.60	70.70	8.23	NS
Albumen height (mm/egg)	19.71	20.19	18.76	19.18	19.49	19.68	0.66	NS

a,b- Means on the same row bearing different superscript differ significantly (P < 0.05), **NS**- No significant difference (P > 0.05), **LOS**- Level of significant difference

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