Effect of diets containing raw and processed pigeon pea seed meal on external and internal egg quality characteristics of laying quails (*Coturnix coturnix japonica*)

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Abstract

Three hundred and sixty, six week old Japanese quail hens (*Coturnix coturnix japonica*) were used to evaluate the effect of processed pigeon pea (*Cajanus cajan*) seed meal (PPSM) on egg quality characteristics of laying birds. The processing methods were soaking (24, 48 and 72 hours), fermentation (72 hours), boiling (60 minutes) and roasting (30 minutes). The birds were divided into eight groups of 45 per treatment each replicated three times with 15 birds per replicate in a completely randomized design. The birds were raised in cages measuring 75cm × 75cm × 60cm. Eight experimental diets were formulated containing processed PPSM at 30 % of diet representing T1 (control), T2 (raw PPSM), T3 (soaked PPSM for 24 hours), T4 (soaked PPSM for 48 hours), T5 (soaked PPSM for 72 hours), T6 (soaked PPSM for 24 hours and fermented for 72 hours), T7 (boiling for 60 minutes) and T8 (roasted PPSM for 30 minutes) respectively. The experiment lasted for 20 weeks. Feed and water were provided ad libitum. The results showed that processed PPSM had no significant ($P>0.05$) effect on egg weight, egg height, egg diameter, egg shape index, egg shell thickness as well as albumen height, albumen diameter, albumen weight, yolk diameter, yolk weight, yolk index and haugh unit across the dietary treatments. It is concluded that raw and processed PPSM had no significant ($P>0.05$) effect on the egg quality characteristics of laying quails. In addition, inclusion of raw PPSM in quail diets posed no threat to the health status of the birds.

Keywords: Pigeon pea, processing, Quail hens, egg quality characteristics

Introduction

The problem of feed shortage arising from sky rocketing prices of conventional protein and energy feed ingredients (e.g. groundnut cake, soybean, maize, sorghum etc) has negatively affected animal protein supply. This however has created a wide gap between the demand and supply of animal protein in Nigeria and many underdeveloped countries of the world. Thus, average animal protein intake of persons in most of these countries is far below the recommendations (Oyawoye, 2002).

Pigeon pea (*Cajanus cajan*) is one of the feedstuff that could serve as a useful alternative (non-conventional protein

sources) to soybean meal and groundnut cake in the diets of poultry birds to improve and sustain livestock production. It is one of the widely grown and moderately yielding legume (300 – 3000 kg/ ha legume dry seeds) in native farms and yield 5000 – 7000 kg/ha under improved cultivation for over 2 -3 years period (Phillip, 1997). It has a crude protein value of 20.6 – 27.7 % and is desirable due to its high nutrient profile (Apata and Ologhobo, 1993). However, the presence of anti-nutritional factors (e.g trypsin inhibitors, tannins, trypsin, haemagglutinin etc.) and their effects limit its use (Amaefule and Nwagbara, 2004). In the recent time, remarkable improvement in the nutritive quality of legumes seeds have

been achieved through various processing methods such as cooking, roasting, soaking and germination, fermentation, dehulling and chemical treatment which exerts beneficial effects by destroying the inherent anti nutritional factors or reduced these toxins to tolerable levels (Kaankuka *et al.*, 2000; Bawa *et al.*, 2003; Matthew *et al.*, 2010).

Japanese quail (*Coturnix coturnix japonica*) was introduced to Nigeria in 1992 in order to bridge the gap between the demand and supply of animal protein in Nigeria and also to expand the poultry subsector through meat and egg production (Ani, 2009). Quails are fast growing poultry species and are very economical to maintain as they require less floor space (Haruna *et al.*, 1997). They are small sized, early maturing, hardy, prolific and have less feed requirement of 20-25 g per day. They come to sexual maturity and egg production early between 5-6 weeks of age and attain market weight of 150-180 g at almost the same age. The meat and eggs are high quality protein with low body fat and cholesterol content making it a choice product for individuals prone to cardiovascular diseases (Haruna *et al.*, 1997; Olubamiwa *et al.*, 1999). However, Quail production requires good management, proper feeding, and availability of fresh clean water all the time and a good market outlet (Dafwang, 2006). The most popular quail species is *Coturnix coturnix* which include *Coturnix coturnix* (European quail), *Coturnix coturnix africana* (African quail) and *Coturnix coturnix japonica* (Japanese quail).

Therefore this study was designed to evaluate the effect of raw and processed PPSM on external and internal egg quality characteristics of Japanese quail hens.

Materials and methods

Experimental site

This study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University – Samaru – Zaria, Kaduna State. It is located within the Northern Guinea Savanna zone of Nigeria, Latitude 11° 12'N and Longitude 7° 23'E, at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm, occurring between the Months of April and September. The dry season begins around the middle of October, with cold weather that ends in February. This is followed by relatively hot – dry weather from March to April, before the onset of rain. The mean maximum temperature ranges between 14°C to 24°C during the cold season while the mean maximum daily temperature is from 19°C to 36°C during the hot season. The relative humidity varies between 19 to 35% during the hot season, and 63 to 80% in the wet season as reported by Ovimap (2012).

Source of seeds and processing

The Pigeon pea seeds used for this study were purchased from Samaru Market in Sabon Gari Local Government Area of Kaduna State, Nigeria.

Processing of pigeon pea seeds

Four processing methods of pigeon pea seeds were used.

Raw pigeon pea sample

For the raw sample, 30 kg of well stored pigeon pea seeds were milled and bagged.

Soaking in water for different hours

Soaking in water for different hours: Thirty kilogram pigeon pea seeds were poured into 75 litres of cold clean water for different hours (24, 48 and 72 hours) at room temperature. The water was drained after each soaking durations and the seeds were

sun dried for four days on a concrete floor. Seeds were then milled and bagged.

Fermentation

Thirty kilogram pigeon peas seeds were soaked in 75 litres of water for 24 hours at room temperature. The water was allowed to drain and the seeds bagged and put into an air – tight polythene bag and allowed to ferment for three days. After 72 hours, the seeds were then sun dried on a concrete floor for four days. Seeds were then milled and bagged.

Boiling for 60 minutes

Thirty kilogram pigeon pea seeds were boiled for 60 minutes. The 75 litres of water was allowed to boil at a temperature of 100°C using fire wood as the source of heat. The seeds were then poured into the boiling water, covered and then allowed to boil again for a specific duration of 60 minutes. The cooked sample was removed after draining the water and dried on a concrete floor for four days. Seeds were then milled and bagged.

Roasting

Thirty kilogram of raw pigeon pea seeds were roasted in a silver pot on a big tripod stand with fire wood supplying a steady flame. The seeds were constantly stirred with a spoon so as to have a uniform roast and prevent the seeds from burning. The roasting was done for 30 minutes. Seeds were then milled and bagged.

Milled pigeon pea seeds processed by the different methods above were incorporated into the dietary treatments at 30% level of inclusion.

Experimental diets

Eight experimental diets were formulated based on the standard requirement (NRC, 1994) as shown in Table 1. Milled pigeon pea seeds processed by different methods as described above were incorporated into the dietary treatments at 30% of diet. Diet T1 (0 % PPSM) formulated with soya bean seed

meal as the main vegetable protein source served as the control. Diet T2 was formulated with raw pigeon pea seeds, while diets T3, T4, and T5 were formulated with pigeon pea seeds soaked for 24, 48 and 72 hours respectively. Diet T6 was formulated with pigeon pea seeds that were soaked and fermented for 3 days. Diet T7 contained pigeon pea seeds boiled for 60 minutes while diet T8 contained pigeon pea seeds roasted for 30 minutes.

Design and management of experimental birds

A total of 360 six – week old female quails purchased from National Veterinary Research Institute (NVRI) Vom, Jos were used. Forty – five (45) birds were assigned to eight dietary treatments which contained 22 % crude protein. T1 served as the control (0 % PPSM) while other diets contained 30 % inclusion of pigeon pea seed meal designated as T2, T3, T4, T5, T6, T7 and T8 with 15 chicks per replicate in a completely randomized design.

The birds were raised in 75cm long × 75cm wide × 60cm high cages. Feed and water were provided *ad libitum*. Drugs were administered as at when necessary and all other routine management practices were duly observed. The experiment lasted for twenty weeks. Eggs were collected twice daily (morning, 9.00a.m and evening, 4.00 p.m.), counted, weighed and recorded per replicate. Three freshly laid eggs representing the average weight of eggs per replicate were used weekly to determine the egg quality parameters throughout the twenty weeks. Egg weights were recorded after which they were carefully broken into a flat plate to assess the internal and external egg quality traits. The shell was washed with distilled water to remove adhering albumen; the egg shell was then dried at room temperature and weighed. Eggs were weighed using an electronic top

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Table 1: Composition of quail layer diets containing differently processed pigeon pea seed meal (7 - 26 weeks)

Ingredients	Treatments							
	1 Control	2 Raw PPSM	3 Soaked PPSM (24hrs)	4 Soaked PPSM (48 hrs)	5 Soaked PPSM 72hrs	6 Soaked +Ferme nted PPSM	7 Boiled PPSM (60mins)	8 Roasted PPSM (30mins)
Maize	51.70	34.37	34.37	34.37	34.37	34.37	34.37	34.37
SBM	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
PPSM	0.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
GNC	30.40	17.73	17.73	17.73	17.73	17.73	17.73	17.73
Bone	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Limestone	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Vitamin Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100
Determined Analysis								
ME (Kcal/kg)	2981	2989	2968	2977	2981	2976	2985	2982
Crude protein (%)	21.44	21.75	22.13	22.06	22.56	22.88	22.63	22.61
Crude Fibre (%)	6.57	6.67	7.41	6.72	7.32	7.32	7.34	7.96
Ether Extract (%)	5.26	5.45	4.92	4.88	4.69	4.41	4.35	4.22
Calculated Analysis								
Calcium (%)	2.70	2.71	2.71	2.71	2.71	2.71	2.71	2.71
Phosphorus (%)	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Lysine (%)	1.10	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Methionine (%)	0.66	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Cysteine (%)	0.36	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Feed cost/kg (₹)	75.18	76.41	76.41	76.41	76.41	76.41	83.08	83.08

*Biomix layer premix provided per kg of diet: Vit A. 12,000 IU; Vit D₃ 1,500 IU; Vit E 10,000mg; Vit K₃ 1,000mg; Vit. B₁ 1500mg; Vit. B₂ 4,500mg; Niacin 15,000mg; Pantothenic acid 4,500mg; Folic acid 1,000mg; Vit. B₆ 3,000mg; Vit. B₁₂ 15.00mg; Vit.C 45,000mg; Biotin 100mg; Choline chloride 300,000mg; Cobalt 20,000mg; Iodine 1000mg; Iron 20,000mg; Copper 3,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg.

SBM = Soybean meal, PPSM = Pigeon Pea Seed Meal, ME = Metabolizable Energy, GNC = Groundnut cake

loading scale. Egg length and diameter (External egg quality characteristics) were measured with venier caliper and egg shape index was calculated as egg diameter divided by the length. After cutting the eggs open to obtain yolk and albumen, the egg shells were carefully washed with water to remove adhering albumen, dried at room temperature and weighed to obtain egg shell weight. Yolk diameter, yolk height and albumen height (Internal egg quality characteristics) were determined using a venier caliper. The haugh unit was calculated using the formula proposed by

Haugh (1937). $HU = 100 \log_{10} (h - 1.7W^{0.37} + 7.6)$, where HU = Haugh Unit, H = Observed height of the albumen (mm), W = Weight of egg (g). Egg shell thickness was measured with a micrometer screw gauge.

Data collection and analysis

All data were subjected to analysis of variance using the general linear model procedure of Statistical Analytic System (SAS, 2008). Significant differences among treatment means were separated using Tukey model.

Table 2: Effect of diets containing differently processed pigeon pea seed meal on external egg quality characteristics of Japanese quail hens (7 – 26 weeks)

Parameters	TREATMENTS								SEM
	1 Control	2 Raw PPSM	3 Soaked PPSM (24hrs)	4 Soaked PPSM (48hrs)	5 Soaked PPSM (72hrs)	6 Soaked + Fermentation	7 Boiled PPPSM (60mins)	8 Roasted PPSM (30mins)	
EXTERNAL QUALITY									
Egg Weight (g)	9.30	9.65	9.82	9.37	9.40	9.40	9.70	9.41	0.80 ^{NS}
Egg Height (mm)	30.23	30.52	30.49	30.36	30.54	30.47	30.60	30.31	0.65 ^{NS}
Egg Diameter (mm)	22.61	22.77	22.81	22.52	22.40	22.63	22.64	22.38	0.43 ^{NS}
Egg Shape Index	0.75	0.75	0.75	0.74	0.73	0.74	0.74	0.73	0.02 ^{NS}
Egg Shell Weight (g)	0.99	1.02	1.00	1.01	1.00	1.01	1.02	0.99	0.02 ^{NS}
Egg Shell Thickness (mm)	0.25	0.25	0.25	0.25	0.25	0.30	0.25	0.25	0.07 ^{NS}
NS = Not significantly (P>0.05) different, SEM = Standard Error of Means, PPSM = Pigeon Pea Seed Meal.									

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Table 3: Effect of diets containing differently processed pigeon pea seed meal on internal egg quality characteristics of Japanese quail hens (7 – 26 weeks)

Parameters	TREATMENTS								SEM
	1	2	3	4	5	6	7	8	
	Control	Raw PPSM	Soaked PPSM (24hrs)	Soaked PPSM (48hrs)	Soaked PPSM (72hrs)	Soaked + Fermentation	Boiled PPPSM (60mins)	Roasted PPSM (30mins)	
INTERNAL QUALITY									
Albumen Height (mm)	2.77	2.89	2.77	2.92	2.92	3.18	2.84	2.89	0.45 ^{ns}
Albumen Diameter (mm)	32.40	32.11	33.96	32.59	31.52	32.55	33.02	33.96	1.88 ^{ns}
Albumen Weight (g)	4.90	5.09	5.14	5.10	4.98	4.79	5.22	4.99	5.58 ^{ns}
Yolk Height (mm)	9.84	9.46	9.14	9.04	9.19	9.36	9.57	9.52	1.36 ^{ns}
Yolk Diameter (mm)	2.21	2.17	2.19	2.19	2.21	2.22	2.20	2.17	0.06 ^{ns}
Yolk Weight (g)	3.42	3.56	3.68	3.25	3.43	3.60	3.51	3.44	0.41 ^{ns}
Yolk Index	0.44	0.43	0.41	0.41	0.41	0.42	0.43	0.43	0.06 ^{ns}
Haugh Unit	77.74	77.44	77.29	77.57	77.46	77.63	77.30	77.42	0.89 ^{ns}

NS = Not significantly (P>0.05) different, SEM = Standard Error of Means, PPSM = Pigeon Pea Seed Meal.

Results and discussion

The result of this study is presented in Table 2 and Table 3. The result showed that all the external egg quality parameters evaluated such as egg weight, egg height, egg diameter, egg shape index and egg shell thickness of birds showed no significant (P>0.05) differences across the dietary treatments. The non-significant difference observed in the external egg quality characteristics of birds could be attributed to balanced nutrient utilization across the treatments.

The internal egg quality parameters evaluated such as albumen height, albumen diameter, albumen weight, yolk height, yolk diameter, yolk weight, yolk index and Haugh unit measured also showed no significant (P>0.05) differences across the dietary treatments. The albumen quality across the dietary treatments was indicated by the Haugh unit values. The non-significant effect noticed in the Haugh unit values was an indication of an improvement in the albumen height and quality caused by feeding PPSM to the quails. The results agreed with the findings of Austic and Nesheim (1990) that Haugh unit was not

influenced mainly by diet but that it was influenced by albumen consistency which was dependent on the age of the hen, genetics and storage of the egg (Jones and Dangl, 2006).

However, the result also showed that inclusion of PPSM had no negative effect on the external and internal egg quality characteristics of the quails. This result was in agreement with the findings of Abeke (2005) who reported that inclusion of lablab seeds in the diets of laying hens had no significant effect on the yolk index, Haugh unit, shell index, shell thickness and shell percentage.

Conclusion

From the result of this study, it can be concluded that inclusion of raw and processed PPSM in the diets of laying quails had no significant effect on their egg quality characteristics. In addition, the inclusion of raw PPSM in the diets posed no threat to the egg quality characteristics and health status of quails.

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