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Growth response, carcass characteristics and egg laying performance of Japanese quail (*Coturnix coturnix japonica*) fed diets containing varying levels of fermented cassava (*Manihot esculenta*) peel meal

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Abstract

*A two phased experimental study was conducted on 300, two-weeks-old Japanese quails to determine the effect of feeding diets containing varying levels of fermented cassava (*Manihot esculenta*) peel meal on the growth performance, carcass characteristics and egg production of Japanese quail (*Coturnix coturnix japonica*). Japanese quails with mean initial body weight of 26.67 g and of mixed sexes were used. Fermented cassava peel meal (FCPM) was prepared by soaking fresh cassava peels in water (that is twice its weight) for three days. Thereafter, the peels were put in a jute bag and kept for 12 hours under a hydraulic press; sun-dried for a few days and milled using an attrition mill. During the growing phase, the birds were randomly allotted to four dietary treatments with 75 birds per treatment, each replicated three times, with the diets containing FCPM replacing 0, 25, 50 and 75 % maize to form diets T_1, T_2, T_3 and T_4 respectively. The diets were isonitrogenous, containing 24 % crude protein, and fed to the experimental birds for six weeks. Data were collected on feed intake, growth performance and carcass characteristics. The laying phase involved 120 female quails from the growing phase that were sexed to retain only the females. They were then allotted to four dietary treatments of three replicates per treatment; with 10 birds per replicate. The birds were fed the experimental diets containing FCPM replacing 0, 25, 50 and 75 % maize for eight weeks, and data were collected on egg production and egg quality parameters. Results show significant ($p<0.05$) differences in daily feed intake and nutrient digestibility among the treatments, while daily weight gain and feed conversion ratio (FCR) were not significantly ($p>0.05$) different, during the growing phase. For the laying phase, there were no significant ($p>0.05$) differences in daily feed intake, hen day production (HDP) and all the egg quality traits determined. Therefore, it can be concluded that dietary maize could be replaced with FCPM up to 50 % and 75 % in growing quails without any deleterious effects on growth performance and carcass characteristics respectively; whereas it can replace up to 75 % in the diet of laying Japanese quails without any adverse effect on egg production and egg quality traits.*

Keywords: Fermented cassava peels, growth response, egg production, Japanese quails

Introduction

One of the major sectors of the livestock industry in Nigeria is poultry production. Years back, this sector was dominated by the rearing of domestic chickens. However, there are new entrants into the sector. One of the birds slowly gaining prominence is the Japanese quail (*Coturnix coturnix japonica*). Japanese quails are suited for commercial rearing, egg and meat production under intensive management (Egbeyale *et al*., 2013). This is because they are hardy birds that thrive in small cages and cheap to produce (Odunsi *et al*., 2007). They have less feed requirements of about 20-25 g of feed per bird per day compared to chicken that requires 120-130 g of feed per bird per day (Ani *et al*., 2009). They require minimal space; and consumption of their meat reduces the chances of hypertension and diabetes because of their low level of cholesterol (Agwunobi and Ina-Ibor, 2007).One of the major constraints to the rearing of quails and other poultry species in Nigeria is the high cost of feed especially energy source feed ingredients such as maize, millet and guinea corn. Competition between man, the industries and livestock for these feed ingredients is often responsible for their high cost (Oladunjoye *et al.*, 2005).Many energy supplying ingredients have been evaluated as possible alternatives to maize (the main energy feed ingredient) in poultry feeding. One of such agro-industrial by-products is cassava peel, a by-product of cassava production which is readily available in the country. The peels account for about 10-15 % of the tuber by weight and contains between 5.00 – 5.98 % crude protein (Idowu *et al.*, 2006). There are limitations to the use of cassava products in poultry feeding because of its dustiness, milling difficulty, reduction in feed intake and an appreciable amount of hydrocyanic acid - an anti-nutritional factor present in it (Essec and Nout, 1989; Salami, 1999). Oladunjoye *et al.* (2008) reported that several processing methods like parboiling, soaking in water (fermentation) and sun drying enhance the feeding value of cassava products; while Omoikhoje *et al.* (2008) reported on the extensive use of cassava peel meal as a cheaper substitute for maize in the diet of monogastric animals. Hence, the objectives of this study were to investigate the growth response, carcass characteristics and egg laying performance of Japanese quails fed diets containing varying levels of fermented cassava peel meal.

Materials and methods

Location of the experimental study

This research study was carried out at the Poultry Unit of the Department of Animal Production, Federal University of Technology, Minna, Niger State, Nigeria. Minna is located within the Southern Guinea Savanna zone and lies between latitude 9^0 28′ and 9^0 37′North and between longitude 6^0 23′ and 6^0 33′ East. The mean annual rainfall is 1000 – 1500 mm (FUTMIN, 2012).

Processing of cassava peel meal

Cassava peels were collected from a cassava processing factory located at Mobil Market, Minna, Niger State. The collected peels were processed into cassava peel meal using the method described by Tewe and Kasali (1986) as follows: Fresh peels were soaked in water at room temperature in an enclosed drum for three days to allow fermentation to take place. Thereafter, they were removed and drained in a basket for about an hour and then spread thinly on polythene sheets to sun dry for a few days. The peels were turned at regular intervals to allow even drying. The dried cassava peels were then milled using an attrition mill and stored in polythene bags as fermented cassava peel meal (FCPM) until needed for use.

The experimental diets

FCPM and other feed ingredients were mixed to produce experimental diets of 24 % crude protein for growing quails. FCPM were used to replace 0, 25, 50 and 75 % maize forming diets T_1, T_2, T_3 and T_4 respectively. While for the laying phase, the experimental diets were formulated to contain 20 % crude protein, with FCPM replacing 0, 25, 50 and 75 % maize as in the growing phase (Table 1).

Management of the experimental birds at the growing phase

Three hundred (300) two-weeks-old Japanese quails sourced from the National Veterinary Research Institute, Vom, Plateau State, and housed in deep litter pens were used for the study. One week before the arrival of the birds, the pens, feeders, drinkers and other equipment were cleaned, washed and disinfected, and 100 watt bulbs installed in the pens. On arrival, 75 birds were randomly allotted to each treatment of three replicates, with 25 birds per replicate. Routine management operations such as feeding, cleaning of the drinkers and regular turning of the litter material to prevent caking were carried out. Data were then collected for 6 weeks on daily feed intake, weekly body weight gain and feed conversion ratio. At the end of the 5th week, a nutrient digestibility trial was carried out using two birds selected randomly from each replicate and kept in metabolism cages for one week. They were adjusted in the metabolism. cages for four days followed by collection of faecal droppings for three days using the total collection method. Collected droppings were oven dried at 65°C for 36 hours; and droppings from each replicate were pooled together and ground. Representative samples were analyzed for their proximate composition based on the procedures of AOAC (1990); and the results obtained used to determine apparent nutrient digestibility.

On the last day of the growing phase, two birds per treatment were randomly selected for carcass analysis. using the procedures of Lamidi *et al.* (2008).

Table 1: Composition of the experimental diets (at both the growing and laying phases) fed to Japanese quails (%)

	Growing phase				Laying phase			
Ingredients	**T_1**	**T_2**	**T_3**	**T_4**	**T_1**	**T_2**	**T_3**	**T_4**
Maize	44.40	33.30	22.00	11.10	48.72	36.54	24.36	12.18
FCPM	0.00	11.10	22.20	33.30	0.00	12.18	24.36	36.54
Groundnut cake	38.90	38.90	38.90	38.90	33.58	33.58	33.58	33.58
Maize offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated values								
ME (Kcal/kg)	2566	2410	2256	2101	2579	2161	1743	1325
Crude protein (%)	24.00	24.00	24.00	24.00	20.00	20.00	20.00	20.00
Crude fibre (%)	3.76	4.51	5.27	6.02	3.68	4.51	5.33	6.16
Methionine (%)	0.30	0.28	0.22	0.23	0.29	0.27	0.24	0.23
Lysine (%)	0.88	0.85	0.82	0.79	0.80	0.77	0.73	0.70

***2.5 kg of the premix supplied the following: Vitamin A (7,500 IU), vitamin D (500,000 IU), vitamin E (1,000 IU), vitamin B_1 (375 mg), vitamin B_2 (125 mg), vitamin B_3 (500 mg), vitamin B_6 (150 mg), vitamin B_{12} (2.5 mg), vitamin K (150 mg), vitamin C (10 mg), folic acid (150 mg), pantothenic acid (14.4 mg), Ca (12.5 mg), Cu (8.0 mg),Fe (32 mg), I (0.8 mg), Se (100 mg), Mg (0.25 mg), Cl (250 mg).**

T_1 = 0 % FCPM; 100 % maize; T_2 = 25 % FCPM; 75 % Maize; T_3 = 50 % FCPM; 50 % maize; T_4 = 75 % FCPM; 25 % maize; FCPM = Fermented cassava peel meal; ME = Metabolizable energy

Management of the experimental birds at the laying phase

At the end of the growing phase of the experiment, 120 female Japanese quails were selected out of the initial 300 stocked such that the females were retained in their original treatments. Sexing was done using the cloacae glands. These emit whitish foamy substances when pressed in the males whereas these were absent in the females (Shim, 2005). The birds were kept for eight weeks in this phase during which time data were collected on feed intake, hen day egg production and egg quality parameters such as egg weight, egg length, egg width, egg shape index, yolk weight, yolk width, yolk height, yolk index, egg shell thickness, albumen height, albumen weight and Haugh Unit based on the procedures of Ayanwale *et al.* (2006).

Chemical analysis

The experimental diets both at the growing phase and laying phase as well as the collected faecal droppings were analysed for their proximate composition using the procedures of AOAC (1990).

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis Software (SAS, 2000, Version 6, SAS Institute, Cary, NC, USA) based on the Completely Randomized Design Model.Where treatment means were significant, they were separated using the Duncan's Multiple Range Test (Duncan, 1955).

Results and discussion

The proximate composition of fermented cassava peel meal (FCPM) and fresh cassava peel meal (FCAP) is shown in Table 2. FCPM has higher crude protein compared to FCAP. This result agreed with the findings of Ganiyu (2006) that fermentation increased the protein, amino acids and vitamins of cassava peels. The fibre content of the FCPM decreased due to the fact that fermentation helps in breaking down the cellulose content of cassava peel (Dairo, 2011).

The growth performance and nutrient digestibility of growing Japanese quails fed diets containing graded levels of FCPM is presented in Table 3. Body weight gain and total feed intake were significantly ($p<0.05$) affected by the replacement of maize with FCPM in the diets of the birds. This agreed with the finding of Ijaiya *et al.* (2002) on higher intake of feed with increasing level of FCPM in rabbit diets.

Table 2: Proximate composition of fermented cassava peel meal (FCPM) and fresh cassava peel (FCAP)

Parameter	FCPM	FCAP
Dry matter	89.50	18.90
Crude protein	5.70	4.23
Crude fibre	14.83	28.60
Ether extract	0.47	3.26
Ash	9.47	7.47
Nitrogen free extracts	59.03	55.50
Metabolizable energy (Kcal/kg)	2632	2681

FCPM = Fermented cassava peel meal FCAP = Fresh cassava peel

Table 3: Performance and nutrient digestibility of Japanese quails fed dietary levels of fermented cassava peel meal

Parameter	T_1	T_2	T_3	T_4	SEM
Initial body weight (g)	26.00	26.67	28.67	29.33	2.77ns
Final body weight (g)	135.87	125.44	136.59	126.70	13.12ns
Body weight gain (g)	109.87^a	98.77^b	107.92^a	97.37^b	10.35*
Daily weight gain (g)	2.77	2.53	2.67	2.53	0.62ns
Total feed intake (g)	685.49^c	674.12^c	772.87^b	967.31^a	77.50*
Daily feed intake (g)	17.02^b	16.73^c	17.85^b	23.06^a	1.87*
Feed conversion ratio	6.14	6.61	6.69	7.11	1.02ns
Apparent nutrient digestibility coefficient (%)					
Dry matter	88.40^b	88.43^b	90.36^a	73.20^c	2.61*
Crude protein	80.47^c	82.42^b	85.15^a	71.92^a	1.87*
Crude fibre	75.41^c	76.81^b	85.00^a	59.23^d	3.53*
Ether extract	95.04^b	95.65^b	97.60^a	83.93^c	2.02*
Ash	74.42^b	70.24^c	82.93^a	59.82^d	2.58*
Nitrogen free extracts	94.13^a	94.33^a	93.73^a	78.33^b	3.14*

^{abcd}Means on the same row with different superscripts were significantly ($p<0.05$) different
T_1 = 0 % FCPM; 100 % maize T_2 = 25 % FCPM; 75 % Maize T_3 = 50 % FCPM; 50 % maize
T_4 = 75 % FCPM; 25 % maize SEM = Standard error of means ns = not significant ($p>0.05$)

The increased feed intake observed in birds fed FCPM might be because it contained more fibre compared to maize which tend to increase the fibre content of the diets containing it thereby diluting the other nutrients especially energy. The birds therefore had to eat more to meet their energy needs to sustain growth and development. This is in agreement with Salami and Odunsi (2003) who reported that increase in crude fibre decreases metabolizable energy (ME) thereby leading to increased feed intake to meet ME requirements. FCR were not significantly (p>0.05) affected by the varying levels of FCPM inclusion in the diets, however, there was a linear increase in FCR as dietary inclusion levels of FCPM increased.

Apparent nutrient digestibility of dry matter, crude protein, crude fibre, ether extract, ash and nitrogen free extracts were significantly affected among the birds fed the various dietary treatments; with quails fed 50 % FCPM having relatively higher values and quails fed 75 % FCPM having significantly (p<0.05) lowest values for all the treatments. This observation is similar to the earlier findings of Salami and Odunsi (2003) and Onyimonyi and Ugwu (2007) that birds could tolerate cassava peel meal at levels up to 50 % at the expense of maize beyond which decrease in body weight, feed efficiency and poor digestibility may result. This could be attributable to higher fibre content, dustiness and powdery nature of the peel meal as well as the residual effect of hydrocyanic acid (an anti-nutritional factor) present in the feed.

The results of the carcass characteristics and carcass proportions of Japanese quails fed diets containing graded levels of FCPM is presented in Table 4. Only the weight of the gizzard and intestine were not significantly (p>0.05) affected by the dietary inclusion of FCPM; all other carcass characteristics, carcass cut-up-parts and weight of internal organs were significantly (p<0.05) affected. This finding agrees with the results of Oruwani *et al.* (2003) who reported no significant effect on the weight of the gizzard of broilers fed diets in which maize was completely replaced by cassava/brewers' dried yeast blend.

Table 4: Carcass characteristics of Japanese quails fed diets containing graded levels of fermented cassava peel meal

Parameter	T_1	T_2	T_3	T_4	SEM
Live weight (g)	255.43^{c}	263.76^{bc}	275.00^{ab}	287.50^{a}	7.07*
Eviscerated weight (g)	190.28^{a}	191.79^{a}	192.29^{a}	181.80^{b}	2.91
Dressing %	76.11^{b}	866.04^{a}	76.54^{b}	90.55^{a}	2.85*
Head (%)	12.70^{c}	14.04^{a}	13.28^{b}	13.31^{b}	1.28*
Legs (%)	5.19^{b}	5.49^{a}	4.92^{c}	5.47^{a}	0.50*
Crop (%)	1.09^{a}	1.99^{a}	2.06^{a}	1.87^{b}	1.33*
Bile (%)	0.35^{a}	0.34^{a}	0.31^{b}	0.31^{b}	0.11*
Gizzard (%)	8.99	8.75	8.46	8.59	0.84ns
Intestine (%)	10.57	10.73	9.74	10.09	4.20ns
Liver (%)	4.81^{a}	3.41^{c}	4.09^{b}	3.40^{c}	0.26*
Heart (%)	2.65^{a}	2.66^{a}	2.36^{b}	2.37^{b}	0.08*
Lungs (%)	2.61^{b}	2.68^{ab}	2.78^{ab}	2.98^{a}	0.37*

^{abc} Means in the same row with different superscripts differ (p<0.05) significantly
T_1 = 0 % FCPM; 100 % maize T_2 = 25 % FCPM; 75 % Maize T_3 = 50 % FCPM; 50 % maize
T_4 = 75 % FCPM; 25 % maize SEM = Standard error of means ns = not significant (p>0.05)

The results of egg production and egg quality traits are presented in Table 5. There were no significant (p>0.05) differences in hen day production (HDP), daily feed intake and all the external and internal egg quality parameters determined among the dietary treatments. The insignificant difference observed in HDP among the birds is close to the findings of Oladunjoye *et al.* (2010) who found that laying chickens are able to tolerate FCPM between the range of 50 to 70 % replacement after which egg production and feed utilization declines. They attributed this to the residual hydrocyanic acid. The insignificant differences observed in all the egg quality parameters determined in this study agreed with the findings of Fafiolu *et al.* (2004) in laying hens fed malted sorghum-based diets. This indicated the adequacy of the diets in meeting the nutritional needs of the laying birds. Hence, it can be concluded that dietary maize could be replaced with FCPM up to 50 % for optimum growth performance and 75 % for carcass quality in growing quails. For laying hens, maize could be replaced up to 75 % with FCPM with no adverse effects on egg production and egg quality traits.

Table 5: Egg production and egg quality traits of Japanese quails fed dietary levels of fermented cassava peel meal

Parameter	T_1	T_2	T_3	T_4	SEM
Hen day production (%)	17.76	22.24	20.86	15.48	8.08ns
Daily feed intake (g)	23.52	26.02	25.38	22.07	6.60ns
Yolk weight (g)	3.24	3.62	3.29	3.31	0.50ns
Yolk width (mm)	2.79	2.82	2.78	2.91	0.15ns
Yolk height (mm)	8.94	9.71	9.81	8.86	2.80ns
Yolk index	3.23	3.45	3.54	4.13	2.70ns
Albumen weight (g)	2.20	2.49	2.66	2.76	0.63ns
Albumen height (mm)	2.96	2.72	2.55	2.74	0.60ns
Shell thickness (mm)	0.20	0.21	0.21	0.21	0.00ns
Egg weight (g)	7.65	8.07	7.79	7.74	1.70ns
Egg length (cm)	2.97	3.13	3.02	3.11	0.17ns
Egg width (cm)	2.48	2.42	2.44	2.49	0.07ns
Egg shape index	0.93	0.86	0.92	0.91	0.07ns
Haugh Unit	84.25	81.97	81.00	83.18	7.60ns

Means in the same row with no superscripts were not significantly ($p<0.05$) different
T_1 = 0 % FCPM; 100 % maize T_2 = 25 % FCPM; 75 % Maize T_3 = 50 % FCPM; 50 % maize
T_4 = 75 % FCPM; 25 % maize SEM = Standard error of means; ns = not significant ($p>0.05$)

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