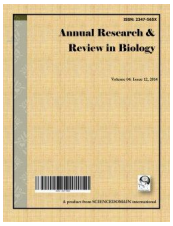

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Carcass and Organ Characteristics of Growing Japanese Quails (*Coturnix coturnix japonica*) Fed Sun-dried Mango (*Mangifera* spp) Kernel Meal as a Replacement for Maize

F. B. Abang[1*], O. K. Oko[2] and J. T. Yelwa[3]

[1]Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria.
[2]Department of Animal Production, College of Animal Science, University of Agriculture, Makurdi, Nigeria.
[3]Department of Animal Science, Faculty of Agriculture, University of Calabar, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author FBA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OKO and JTY managed the analyses of the study. Authors FBA and JTY managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A study using complete randomized design (CRD) was carried out to assess the effect of Sun-dried Mango Kernel Meal (SMKM) on the carcass and organs characteristics of growing Japanese quails *(Coturnix coturnix japonica)*. One hundred and forty four unsexed Japanese quails of about three weeks old were randomly selected and grouped into three treatments containing SMKM that replaced maize at 0%, 25% and 50% (TI, TII and TIII respectively) in properly compounded experimental diets. Each treatment was replicated thrice with sixteen (16) quails per replicate. The results of this study showed that SMKM did not influence the terminal live weights, carcass, dressed and neck weights of quails. In terms of organ weights, it was observed that SMKM affected the

**Corresponding author: E-mail: abang.favour@yahoo.com, abang.favour2@gmail.com;*

lungs, heart and kidney weights significantly (P<0.05) across treatments. The relative organs weights showed significant (P<0.05) differences in heart, intestine, lungs and kidney weights but the reverse revealed with the gizzard and liver weights. However, the relative weights of drum stick, back and breast muscles were significantly (P<0.05) different across treatments. It is concluded that sun-dried mango kernel meal could replace maize up to 50% in quails' diets, however, choice cut-part of quails were compromised.!

Keywords: Quails; mango kernel; maize; carcass and organ characteristics.

1. INTRODUCTION

In recent times, a new genus of poultry, Japanese quail *(Coturnix coturnix japonica)* was introduced into Nigeria by the National Veterinary Research Institute (NVRI) Vom to expand the poultry sub sector and help supplement the domestic chicken production through meat and eggs (Edache et al. [1]; Ani et al. [2]). The quails have unique characteristics and advantages over other species of poultry which include early attainment of sexual maturity, short generation interval making it possible to have many generations in a year (Anon [3]), high rate of egg production between 200-300 eggs in 360 days and are very resistant to common epidemics of poultry (NRC [4]). Quails are birds which thrive very well in cages and are relatively inexpensive to maintain. They are birds that every household can keep without stress. The common Japanese quail matures in about six weeks and are usually in full egg production by 50 days of age. If properly mated, quail birds have high fertility and good egg hatchability.The Quails are hardy birds that can adapt easily to different environments (Haruna et al. [5]). Their meat and eggs are renowned for their high quality protein, high biological value and low caloric content, making it a choice product for hypertensive patient (Haruna et al. [5]; Olubamiwa et al. [6]). Despite all these benefits, there are no improved feeding regimes, the most relevant option to arrest the present feed crisis of the livestock industry is by-product utilization (Atteh [7]). These point clearly to alternative feed stuff for livestock feed production in order to cut down feed prices and make them more affordable by livestock farmers. As a result of shortage of conventional feed stuffs, livestock nutritionists have continued with their search for alternative feedstuffs. These alternative feed must be cheap, readily available and less competed for by man and industries or not competed for at all (Akinmutimi [8]). The search for substitute has led to the discovery of non-conventional energy feed such as cocoyam, cassava, mango kernel etc (*Mangifera indica L.*) mango kernel is a good source of soluble carbohydrates (Saadany et al. [9]; Jansman et al. [10]; Teguia [11]; Diarra et al. [12]). The protein of the kernel (7.80 – 8.00%) is comparable to that of maize but it has higher fats (7.80 – 9.00%) than maize (Saadany et al. [9]). Mango kernel flour is reported to be equal to rice in food if tannin free (Morton [13]). Tannins are known to interfere with protein digestibility and render it unavailable. There are other anti-nutrients contained in mango kernel such as; phytate, hydrogen cyanide, Trypsin inhibitor, oxalate, saponin etc. processing methods such as; boiling, fermentation, drying have been reported to be effective in reducing these anti-nutrients (Abang et al. [14]; Diarra et al. [12]).

2. MATERIALS AND METHODS

2.1 Experimental Site

This experiment was conducted at the poultry unit of the Teaching and Research Farm of the Federal University of Agriculture, Makurdi, Benue State. Makurdi is located at longitude 6°10' East and latitude 6°8' North. The area is warm with a minimum temperature range of 29.8-35.6°C. Rain fall is between 508-1016 mm and relative humidity is 47% -87% (Tac [15]). One important geographical features of this area is the River Benue which divides Makurdi into the Northern and Southern parts. Makurdi local government has an area of 16 km radium. It lies within the Guinea savannah region of the Nigeria vegetative belt located in the Benue valley. Makurdi experiences a typical tropical climate with two distinct seasons (dry and wet). The dry season begins in November and ends in March while the wet season starts in April and ends in October. Hama than with cool weather is experienced from December to early February (Tac [15]).

2.2 Preparation of Experimental Materials

Mango seeds were collected during the month of May (peak of the mango season) in Gboko and

Makurdi area of Benue State, Nigeria. Mango kernel was removed by cracking manually with the aid of hammer. The kernel was sun-dried for 7 days in order to reduce the moisture content to less than 10% for prolonged storage. Soybean was well toasted to a dark brown colour to reduce the level of anti- nutrients such as tannin, oxalate, trypsin inhibitors, saponin, phytate, flavonoid, cyanides etc. The ingredients were crushed separately into fine grit (maize and soybean) and were later mixed at varying inclusion levels with other ingredients to formulate the various diets.

2.3 Chemical Analysis

Chemical analysis of sun-dried mango kernel and experimental diets were analysed using AOAC (2000) methods.

2.4 Formulation of Diets

Feeds were formulated to meet the nutritional requirements of quails during the growing phase.Sun- dried mango kernel meal replaced maize at 0%, 25% and 50% in treatment I, II and III respectively.

2.5 Animal Grouping

A total of one hundred and forty four two weeks old un-sexed Japanese quails of about 26.56±0.02 g of weight purchased with the National Veterinary Research Institute Vom- Jos, Nigeria were studied over a period of four weeks (19th June-18th July). The birds were randomly selected at the expiration of one week acclimatization and allotted to three dietary treatments (I- III) of 48 quails each. Each treatment was replicated thrice with 16 quails per replicate. The experiment lasted for four weeks by this time quails were six weeks old.

2.6 Housing

The birds were managed intensively in cages of three tiers. Each tier was separated with wood.Wire mesh was used for the walls and doors to allow adequate ventilation/lighting. The dimension of eachtier was (1.0 m^2 x 0.78 m^2). Litter materials (wood shavings) were used on the wooden floors. Each tier was equipped with adequate drinkers and feeding troughs. A floor space of about 0.007 m^2 to 0.009 m^2 per quail was provided. Artificial lighting was provided with the use of one kerosene lantern for each tier to ensure adequate feed intake.

2.7 Routine Operations

Feeds were weighed with a micro scale balance of 2 kg before serving to ensure a uniform amount across treatments. Quails were served with 200 gms of feed for the first week at about 8.am on a daily basis,the quantity was increased by 50gms on weekly basis. Fresh clean water was supplied daily *ad-lib*. Drinkers and feeders were washed and disinfected using izal when appropriate. Litter materials were changed when due and replaced accordingly. Manure was sold to generate revenue whenever litter materials were changed.

Table 1. Composition of diets with Sun-dried Mango *(Mangifera spp)* Kernel meal for broiler Japanese quails *(Coturnix coturnix japonica)*

Ingredients	Inclusion levels		
	0%	**25%**	**50%**
Maize	55.20	39.90	26.60
Mango	0.00	13.30	26.60
Full-fat soybean	26.67	25.87	25.37
Fish meal	5.20	6.00	6.50
Wheat offals	6.93	6.93	6.93
Bone meal	7.00	7.00	7.00
Salt	0.50	0.50	0.50
Vit/Min premix	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**
Calculated nutrients			
Crude protein (%)	21.87	21.63	21.34
M.E (Kcal/Kg)	2836.47	2846.12	2846.39
Analysed nutrients			
Crude protein (%)	22.02	21.75	21.70
M.E (Kcal/Kg)	2845.01	2900	2950

2.8 Data Collection

At the end of the experiment (28th day or 4th week), three quails per treatment (one from each replicate) were randomly selected and weighed. Quails were slaughtered by cutting their jugular veins with a sharp knife and allowed to bleed. After that the carcasses were weighed one after the other in the various treatments and scalded in warm water to soften the follicle of the feathers for easy removal followed by de-feathering and then evisceration. The carcasses were finally cut into various parts and each part was weighed and kept separately according to treatments.

2.9 Design/Statistical Analysis

The data obtained on all the parameters studied were subjected to one-way analysis of variance (ANOVA) and least significant method (LSD) was used to separate means that differed significantly (Steel and Torrie [16]). Result were presented as mean $\pm$ standard error of mean (SEM).

3. RESULTS AND DISCUSSION

Terminal carcass cuts are presented in Table 2 and relative carcass weights in Table 3. Live weight, carcass, neck and dressed weights showed no significant (P>0.05) difference across the treatments. This result was different from the reports of Okon et al. [17] who recorded significant (P<0.05) differences in all these parameters when quails were fed boiled taro cocoyam meal. The heads and shanks weights of quails fed the control diet were significantly (P<0.05) higher than those fed 50% SMKM. Quails fed 25% SMKM had similar results with those fed 50% diets. It was observed that, the back, breast and drum stick weights of quails fed 0% diet were heavier than those fed other diets. However, quails in TII had significantly (P<0.05) higher values than those in TIII. Lastly, the wing weights of quails fed 50% SMKM had the least values when compared with the control, however, quails placed on 25% and 50% had similar results. The low values recorded with increased supplementation may be due to the presence of anti nutrient as sun-drying could not reduce these phytochemicals to a more tolerable level.

There were no significant (P > 0.05) differences in the relative live weights, dressed weights, carcass weights, neck weights and wing weights across treatments. However, significant (P < 0.05) differences were recorded in relative breast, back, and drum stick weights. These results were different from those reported by Okon et al. [17] who observed no significant (P < 0.05) differences in these aforementioned parameters when quails were fed boiled sun-dried taro cocoyam meal. Quails fed the control diet had significantly (P < 0.05) higher values of relative breast weights than quails fed 50% sun-dried mango kernel meal (SMKM). However, quails fed 25% SMKM were mid- way 0% and 50%. The relative back weights of quails fed 0% (control) were significantly (P<0.05) different from those placed on 25% and 50% diets, however, quails fed 25% SMKM had significantly (P<0.05) higher values than quails fed 50% SMKM. In terms of relative drum stick weight, quails fed sun-dried mango kernels meal in TII and TIII recorded significantly (P<0.05) lower values than those fed 0% SMKM, Probably, because of the presence of anti nutrients.

Terminal organ weights and relative organ weights are presented in Tables 4 and 5 respectively. Liver, gizzard and intestine weights were not different across the treatments. However, significant (P < 0.05) differences were recorded on heart, lungs and kidney weights. These results were in contrast with those of Okon et al. [17] who observed only significant (P<0.05) differences in the intestine weights .Quails fed 50% diets had least kidney and heart weights whereas those fed control diet had highest weights. The lungs weight of quails fed 50% SMKM were higher than those fed control diet but there was no significant (P > 0.05) difference between quails fed 25% SMKM and those fed control diet. The differences observed may be as a result of the processing methods adopted and the test ingredients.

There were no significant (P > 0.05) differences in the relative liver and gizzard weights of quails fed sun-dried mango kernel meal (SMKM). The relative heart weights of quails fed 0% SMKM had significantly (P < 0.05) higher values than quails fed 50% SMKM. Moreover, quails fed 25% SMKM showed no significant (P > 0.05) difference with quails fed 0% and 50% diets. It was observed that, the relative lungs weight of quails fed control diet and 25% SMKM were significantly (P < 0.05) different from those fed 50% SMKM. The result equally revealed that quails in TII and TIII had significantly (P<0.05) lower values of relative kidney weights than

those in TI. Intestine weight of quails in T11 and T111 were significantly (P<0.05) higer than those of T1. The results for relative organ weights were in contrast with those of Okon et al. [17] who observed no significant (P>0.05) differences except for the intestine weights.

Table 2. Effect of graded levels of sun-dried mango kernel meal on terminal carcass weight of quail at six weeks of age (g)

Parameter	Treatment levels		
	0%	25%	50%
Average weekly feed intake	23.37±2.46[a]	18.39±2.73[ab]	14.56±2.00[b]
Average weekly weight gain	14.29±3.38[a]	8.71±1.69[ab]	7.14±2.07[b]
Efficiency of feed utilization	1.39±1.32	1.57±0.33	1.98±2.45
Live weight	86.06±6.18	82.68±7.65	74.64±3.49
Carcass weight	80.84±5.44	72.29±6.04	63.94±2.66
Dressed weight	60.29±4.68	55.92±5.49	47.40±2.40
Drumstick	14.08±1.46[a]	10.10±1.03[b]	8.97±0.99[c]
Head	4.89±0.10[a]	4.19±0.15[b]	3.95±0.13[c]
Neck	4.42±0.25	4.73±0.30	4.21±0.28
Breast	19.06±1.86[a]	15.85±1.50[b]	10.55±0.71[c]
Back	13.48±0.95[a]	10.75±1.54[b]	7.10±1.14[c]
Shank	1.69±0.11[a]	1.38±0.11[b]	1.19±0.09[c]

Different superscripts (a, b and c) within row indicate significant (p<0.05) differences at specified level

Table 3. The effect of graded levels of sun-dried mango kernel meal on relative carcass weight of Japanese quail at six weeks of age (g)

Parameters(g)	Treatment levels			
	0%s	25%	50%	SEM
Live weight	86.06	82.68	74.64	14.77
Carcass weight	95.06	92.10	85.86	10.61
Dressed weight	70.74	67.79	63.66	8.81
Drum stick	17.34[a]	13.09[b]	12.19[b]	5.73
Head weight	5.77	5.25	5.33	0.82
Neck weight	5.27	5.87	5.65	0.96
Breast weight	22.35[a]	19.87[ab]	14.16[b]	4.02
Back weight	16.18[a]	13.32[b]	9.47[c]	4.16
Shanks weight	2.01	1.78	1.64	0.48
Wing weight	5.52	5.92	4.40	1.40

Different superscripts (a and b) within row indicate significant (p<0.05) differences at specified levels

Table 4. Effect of graded levels of sun-dried mango kernel meal on terminal organs weight of Japanese quail at six weeks of age (g)

Parameter	Treatment levels		
	0%	25%	50%
Liver	1.38±0.18	1.55±0.18	1.27±0.07
Heart	0.91±0.13[a]	0.76±12[b]	0.51±0.04c
Lungs	0.71±0.06b	0.74±0.07[b]	1.27±0.07[a]
Gizzard	2.45±0.20	2.44±0.14	2.08±0.18
Kidney	1.36±0.25[a]	0.70±0.20[b]	0.60±0.10b
Intestine (intact)	2.90±0.16	3.27±0.25	3.11±0.28

Different superscripts (a and b) within row indicate significant (p<0.05) differences at specified level

Table 5. The effect of graded levels of sun-dried mango kernel meal on relative organ weights of Japanese quail at six weeks (g)

Parameters	Treatment levels			
	0%	25%	50%	SEM
Heart weight	1.05[a]	0.92[ab]	0.67[b]	0.22
Lungs weight	0.83b	0.89b	0.95a	0.19
Liver weight	1.57	1.99	1.70	0.50
Gizzards weight	2.94	3.17	2.79	0.96
Kidney weight	1.5[a]	0.91[b]	0.6c	0.42
Intestine weight	3.34[b]	4.09[a]	4.15[a]	0.83

Different superscripts (a, b and c) within row indicate significant (p<0.05) differences at specified levels

4. SUMMARY, CONCLUSION AND RECOMMENDATION

The inclusion of sun-dried mango kernel meal in quails' diet as an alternative energy source affected the choice quails' parts like the drum stick, breast muscles and back weights with quails fed 0% diets having the highest values. There was no significant (P > 0.05) difference in terminal liver, heart, gizzard, intestine weights and relative gizzard and liver weights across treatments. However there was hypotrophy (reduction in size) of the kidney with increased levels of SMKM across treatments and hypertrophy (increase in size) of the lungs with increased supplementation across treatments. It is recomended that: sun-dried mango kernel meal should not exceed 25% inclusion level in quails' diets as it exerted a negative influence on most cut-parts and organ weights, another processing method such as fermentation be employed inorder to reduce these anti nutrients to a more tolerable state.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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