International Journal of Agricultural Research and Food Production
ISSN: 2536-7331 (Print): 2536-734x (Online)
Volume 4, Number 3, September 2019
http://www.casirmediapublishing.com

EFFECT OF GRADED LEVELS OF FERMENTED MANGO (*Mangifera spp*) KERNEL COMPOSITE MEAL ON THE SEROLOGICAL PARAMETERS OF LAYING JAPANESE QUAILS (*Coturnix coturnix japonica*)

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ABSTRACT
An experiment was conducted using one hundred and nine five (195) unsexed laying Japanese quails of about two weeks old to investigate the effect of graded levels of fermented mango kernel composite meal (FMKCM) on the health status of quails. The results for serum biochemical composition showed that serum sodium (Na^+), serum chloride (Cl^-), serum bicarbonate (HCO_3^-), serum creatinine; ALT, AST and Total Bilirubin were within normal reference ranges. However serum potassium rose slightly above the normal references range. It is concluded that FMKCM could replace maize up to 25% without any nutritional disorder, as the parameter that was not within the normal reference range did not follow a regular pattern and these observation were applicable to the control experiment as well, revealing that diets would not have accounted for these irregularities.
Keywords: fermented mango kernel, maize, Japanese quail, serological indices

INTRODUCTION
Mangoes are second largest tropical fruit crops grown in warmer regions over the world. Mango tree in Nigeria is perhaps the most popular cosmopolitan fruit tree, which spreads from the mid-belt savannah land to the forest region of southern Nigeria making it abundant. Mango fruit contain vitamins, mineral, organic acids, carbohydrates, amino acids, protein and fatty acids (Arogba, 1989). The fruits are acidic, astringent and rich in ascorbic acid during ripen process. Free sugars including glucose, fructose and sucrose generally increase during ripening giving the fruit turpentine to sweet tasting flavor varying with species (Porter, 2011). Mango kernel a by-product of mango fruits is high in magnesium, phosphorus, calcium, potassium and sodium. Potassium is an essential nutrient and has an important role in the synthesis of amino acid and protein. Calcium and magnesium play a significant role in photosynthesis, metabolism, nucleic acids and body agent of cell agents. Calcium assists in teeth, egg shell formation, magnesium is essential mineral for enzyme activity like Ca^{2+} and Cl-, Mg also plays a role in regulating the acid- alkaline balance in the body. Phosphorus is needed for bone growth, kidney function and cell growth. It equally plays a role in maintaining the body's acid- alkaline balance (Fallon and Enig, 2001).

However, mango kernel contain antinutrients and toxic compound such as tannins, phytate, cyanide, trypsin inhibitor, oxalates and saponin which render them unsafe as carbohydrate sources in poultry production. This anti- nutritional factors bind (chelate) with divalent ions like; Mg^{2+}, Fe^{2+}, Zn^{2+}, and Ca^{2+} and also react with the charged groups of protein and polysaccharides forming indigestible complexes while toxic substance interfere with nutrient bioavailability and utilization. The presence of these antinutrients necessitated the need for serum biochemical assay. Blood assay are vital tools that help detect any deviation from normal in the animal (Ogunbajo *et al.*, 2009). The examination

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of blood gives the opportunity to investigate the presence of several metabolites and other constituents in the body of animals and its plays a vital role in the physiological, nutrition and pathological status of an organism (Ganti, 2009)

MATERIALS AND METHODS

Experiment 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 the longitude 6° 10′ East and latitude 6°8′ North. The area is warm with a minimum temperature range of 29.8-35.6°C.Rainfall is between 508-1016mm and relative humidity is 47%-87%. 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 16km radius. 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. Harmathan with cool weather is experienced from December to early February (Anon, 1995).

Preparation of Experimental Materials

Different cultivars of both indigenous and improved mango 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 fresh kernels were soaked in water at room temperature to allow it ferment for a period of 2 days (48hrs) in order to reduce the anti-nutrients to a more tolerable level and rinsed thoroughly with clean cool water. The fermented kernel was sundried in order to reduce the moisture content to less than 10% to prevent microbial build up and for prolonged storage. The ingredients were crushed separately into fine grit and were later mixed at varying inclusion levels with other ingredients to formulate the various diets.

Chemical Analysis

Chemical analysis of fermented mango kernel and experimental diets were analyzed using (A.O.A.C, 1995).

Formulation of Diets

Feeds were formulated to meet the nutritional requirements for quails during the growing phase. Fermented mango kernel composite meal replaced maize at 0% (control diets was compounded with 100% maize and 0% FMKCM) 10% (diet was compounded with 90% and 10% FMKCM) 15% (diets was compounded with 85% maize and 15% FMKCM) 20% (diet was compounded with 80% maize and 20% FMKCM) and 25% (diet was compounded with 75% maize and 25% FMKCM) in treatments I, II, III, IV, V respectively.

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Animal Grouping

A total of one hundred and ninety five two weeks old un-sexed Japanese quails of about 33.60g of weight purchased with the national veterinary research institute Vom –Jos, Nigeria. At the start of the feeding trial, three groups were allotted to five dietary treatments of 39 quails each. Each treatment was replicated thrice with 13 quails per replicate.

Housing

The birds were grown intensively in cages of three levels. Each level was separated with wood. Wire mesh was used for the walls and doors to allow adequate ventilation/lighting. The dimension of each level was (1.0m^2 x 0.78m^2). Litter materials (wood shaving) were used on the wooden floors. Each level 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 battery lantern for each level to ensure adequate feed intake.

Routine Operations

Feeds were weighed with a micro scale balance of 5kg before serving to ensure a uniform amount across treatments. Quails were served with 250grams of feeds for the first week at about 8 am on daily basis, the quantity was increased by 50grams on weekly basis. Fresh clean water was supplied ad-libitum. Drinkers and feeders were washed and disinfected using disinfectant when appropriate. Litter materials were changed when due and replaced accordingly.

Table 1. Composition of Diet with Fermented Mango (*Mangifera spp*) Kernel Composite Meal (FMKCM) for Laying Japanese Quails (*Coturnix coturnix japonica*)

INGREDIENTS	(0%)	(10%)	(15%)	(20%)	(25%)
Maize	52.00	47.40	45.10	42.80	40.50
FMKCM	0.00	4.60	6.90	9.20	11.50
Soybean meal	23.00	23.00	23.00	23.00	23.00
Groundnut cake	16.00	16.00	16.00	16.00	16.00
Bone meal	7.00	7.00	7.00	7.00	7.00
Lysine	0.50	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Vit/min premix	0.50	0.05	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Analyzed nutrients:					
Crude protein	20.85	20.96	21.02	21.07	21.13
M.E(Kcal/kg)	3043.42	3050.36	3051.09	3061.22	3069.61

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Key: M.E= Metabolizable energy; FMKCM= Fermented mango kernel composite meal

Design and Analysis

At the end of the experiment (12 weeks of age) two (2) laying quails per replicate (amounting to 6 quails per treatment) were randomly selected. Quails were slaughtered by cutting the jugular vein with sharp knife. The blood samples were collected at slaughter into sterile container and the serum was separated by centrifuge at 750g for 15minutes and stored in a deep freezer until time of use for serum biochemical analysis. Serum biochemical analysis was carried out using routine standard procedures (Olerede *et al.,* 1996). The data obtained on all the parameters studied were subjected to one-way analysis of variance (ANOVA) using Minitab statistical software version 14 Minitab (2014) and least significant method was used to separate means that differed significantly (Steel and Torries, 1980).

RESULTS AND DISCUSSION

The results for serum biochemical composition of laying quails are presented in Table 2. Serum sodium (Na^+) was within normal range (144.35-154.33) in this study when compared with the established reference (135-155) for laying Japanese quails by Scholtz *et al.* (2009). This result was in agreement with the report of (Abang *et al.,* 2018) who reported that the serum sodium (Na^+) of quails fed sun-dried mango kernel meal was within normal range across treatments. Serum sodium is a major component of the cat ions of the extracellular fluid and is largely associated with chloride and bicarbonate in regulation of acid-base balance. It's important in the maintenance of osmotic pressure of body fluid, thus protecting the body against excess fluid loss (dehydration) low levels of sodium affects growth in animals and reduced digested protein utilization. Serum potassium (K^+) of quail rose slightly above the upper limit (5.27-6.47) when compared with the normal reference range by Scholtz *et al.* (2009). Serum potassium gives a true picture of the heart condition, it control the heart beat rate and blood pressure and also assist in the regulation of acid base balance of cellular exchange within hydrogen (El- boushy and Vander poel, 1990; Diarra *et al.,* 2010).

The fact that the diversions from the normal range did not follow a regular pattern and this observation were applicable to the control as well, revealing that diets will not have accounted for this anomaly. Serum chloride was within normal range in all the treatments (83-97μm/L) when compared with the normal reference range (81-106) by (Campbell, 1988). This result was in agreement with the finding of (Diarra *et al.,* 2010) who reported that the serum chloride of broiler finisher fed diets containing boiled mango kernel meal (96-100) was within normal reference ranged across treatment. And also disagree with the report of (Abang *et al.,* 2018) who observed slight increase in serum chloride above upper limits in quails fed control diet and 50% sundried mango kernel meal. Hyperchloremia is sometimes associated with excessive fluid loss, such as diarrhea. Hyperchloremia can be symptomatic with signs of weakness and intense thirst (Cambier *et al.,* 1998). Serum bicarbonate (HCO_3^+) was within normal range (23-25) as established by Scholtz *et al.* (2009) (22-30) this result was in agreement with the report of (Abang *et al.,* 2018) who

observed that serum bicarbonate of quails fed sundried mango kernel meal was within normal range. This implies that, the acid-base ratio was balanced. Low levels of serum bicarbonate results in metabolic acidosis (Kasimatic *et al.,* 2005). Serum Creatinine was within normal range (4.3-6.20) comparing with the established reference range by Scholtz *et a*l. (2009).

The report of Creatinine agrees with that of (Abang *et al.,* 2018; Abang *et al.,* 2017) who had similar results but was in contrast with the reports of (Sobayo *et al.,* 2013) who observed values below the lower limits across treatment. Serum ALT and AST were within normal range (5.3-7.6 ALT; 244-479 AST respectively) when compared with the established reference range by (Duke *et al.,* 1975; Scholtz *et al.,* 2009) (4.5-8.5 (ALT); 243-562 (AST). These results were in agreement with that of (Diarra *et al.,* 2010) who fed sundried mango kernel meal to laying quails. Results for AST showed significant ($P<0.05$) difference across treatments with diets containing 25% fermented mango kernel meal having highest value. It was observed that the value increased with increased supplementation across treatment. These values may have increased as a result of increasing doses of oxalates crystals of about 780mg/100g are known to cause renal damage, kidney stone, low plasma and corrosive gastro-enteritis (Kelsely, 1985). However, the doses were not high enough to cause necrotic effect on the liver and kidney, implying that the liver and kidney of quails fed fermented mango kernel composite meal were normal and healthy as high values usually represent kidney and liver damage. Total Bilirubin was within the normal reference range by Scholtz *et al.* (2009) (3.6-14.2µm/L).

The report of the total Bilirubin agrees with that of (Diarra *et al.,* 2010) who fed boiled mango kernel composite meal in broiler diet. Total Bilirubin is indicators of protein adequacy (Ahamefule *et al.,* 2008). A high value of Bilirubin signifies liver disease such as hepatitis or blockage of tubes (bile duct) or diagnose condition that cause increased destruction of red blood cells (Robin, 2013) as well as protein inadequacy (Kwari *et al.,* 2011).The finding showed that up to 25% inclusion levels of fermented mango kernel meal in quail's diets, supplied nutrients sufficient for basic maintenance and metabolic functions of quails. Probably because of low presence of anti-nutrient such as tannin, trypsin, phytate in fermented mango kernel meal. Tannin are known to form complexes with proteins and limit their availability whereas phytate affects the bioavailability of minerals (Ojiako and Igwe, 2008). It is therefore, concluded that fermented mango kernel meal can be included in quails diets up to 25% without deleterious effects.

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Table 2: Serum Biochemical Indices of Laying Quails Fed Diets Containing Graded Level of Fermented Mango Kernel Composite Meal (FMKCM).

Parameters	(0%)	(10%)	(15%)	(20%)	(25%)	SEM	P-Value
Na^+ (µmol/L)	146.67	149.67	144.33	145.33	154.33	5.01	0.07
K^+ (µmol/L)	6.00	5.47	5.27	6.47	6.30	0.23	0.07
CL^- (µmol/L)	97.67^a	83.33^c	84.67^b	83.00^d	85.00^b	3.61	0.03
HCO_3^- (µmol/L)	24.00	23.00	25.00	25.00	25.00	2.21	0.93
Creatinine (µmol/L)	4.30	4.50	5.80	6.10	6.20	0.32	0.06
ALT (Tu/L)	5.30	6.00	6.50	6.80	7.60	0.11	0.62
AST (Iu/L)	244.00^e	256.00^d	264.00^c	334.00^b	479.00^a	9.04	0.04
Total Bilirubin (µm/L)	7.00	7.80	8.60	9.42	10.53	0.54	0.69

Mean with different superscripts (a, b, c, d, e) within the same row differed significantly ($P<0.05$)
SEM= Standard error of mean
Na+ = Sodium;
K+ = Potassium;
CL^- = Chloride;
HCO_3^+ = Serum bicarbonate;
ALT = alanine amino transferase;
AST= Aspartate amino transferase

CONCLUSION

It is concluded that FMKCM could replace maize up to 25% without any nutritional disorder in quails diets as the only parameter measured (K^+) that was not within the normal reference range were applicable to the control experiment, thereby, revealing that diets would not have influenced the result.

RECOMMENDATIONS

It was recommended that up 25% of FMKCM be included in quail's diets without deleterious effects.

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