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Research Article

Egg Quality Characteristics of Japanese Quails (*Coturnix coturnix japonica*) Fed Graded Levels of Fermented Mango Kernel (*Mangifera spp*) Composite Meal

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ABSTRACT

A study was conducted to investigate the effect of FMKCM on the egg quality parameters of Japanese quails. One hundred and ninety five Japanese quails were randomly allotted to five dietary treatments (I –V) of 39 hens each. Each treatment was replicated thrice with 13 hens per replicate. In each of the five diets, FMKCM was used to replace maize at 0%, 10%, 15%, 20% and 25% for i, ii, ii, iv, and v, respectively. Quails in this study were fed over a period 84 days. Feed intake was measured daily and quails were weighed weekly. Eggs were collected on weekly basis for egg quality analysis. Results showed that all the egg quality parameters of quails fed treatment iv and v were significantly (P>0.05) higher than those fed other treatments. The results suggested that FMKCM could replace maize up to 25% without adverse effects, but for premium egg quality, replacement should not exceed 25%.

Key words: Egg quality, Japanese quails, fermented mango kernel, maize

INTRODUCTION

The high cost of ingredients for livestock feed formulation has now almost crippled the livestock industry in developing countries. The most logical step to take in the face of dwindling raw materials supplies is to formulate livestock feeds from non- conventional and non competing (with human being) ingredient by utilizing by products and wastes from plant food processing, which are not directly utilizable by man (Ogunfowora, 1984).

Bamgbose *et al*. (2004) reported that maize *(Zea mays)* as a major energy source in poultry feeds accounts for between 50 and 55% of most poultry feeds. It is equally used in human nutrition thus creating a stiff competition between man and livestock. The resulting effect is high cost of feed translating into high cost of animal products. This has necessitated the search for substitutes such *as* agro-industrial by-products and other farm residues that can replace maize wholly or partly like mango seed kernel meal (*Mangifera indica*) (Kperegbeyi and Onwumere, 2007).

Mangoes are grown practically all over the warmer regions of the world (Kochlar, 1981). Mango has been reported to be the second largest tropical fruit crop in the world (Pennock and Maldonaldo, 1962). In Nigeria, the mango tree is perhaps the most popular cosmopolitan fruit tree, spreading all over the country from the mid-belt savannah land to the forest region of southern Nigeria. This makes mango fruits abundant (Arogba, 1989).

Over the years in Nigeria, mango pulp by-products such as mango seeds have not received enough attention in terms of utilization; they are regarded as wastes or seeds for propagation. Nutritional and toxicological evaluations conducted on mango seed kernels have indicated their suitability as an ingredient in poultry rations. Mango seed kernels have been reported to be good source of carbohydrate (79.2%) and also contain 7.5-13% protein, 7.3-14.4% fat, 2.0% fiber, 2.6% mineral, 0.21% calcium and 0.22% phosphorus, depending on the variety (Kiflewahid *et al*., 1982; Ravindran and Rajaguru, 1985; Arogba, 1989).

Mango seed kernel meal (MSKM) has been reported to be a good non conventional ingredient. Faniyi (1997) reported its importance in poultry production while Arogba (1997) provided the physical, chemical and functional properties of Nigerian mango *(Mangifera indica)* kernel when processed into flour. Chemical analysis and metabolizable energy of mango seed kernel meal as determined by Arogba (1997) revealed that it contains

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Tannin an astringent compound, thus necessitate processing the seed before it could be safely fed to animals. The nutrient composition of Mango seed kernel on dry matter basis was estimated in Nigeria to be 6.16% crude protein, 13.63% ether extract, 2.23% ash and 73.35% nitrogen free extract (Farinu *et al.* 2006) while EI-Alaily *et al.* (1976) reported that the gross energy is 4.7Kcal/g.

Porter (2011) reported that mango kernel has Metabolizable energy of 3527.34Kcal/Kg. This value was higher than that of maize (3390 Kcal/Kg) reported by Tuleun *et al.* (2005). In recent work, anti-nutritional factors caused reduction in the useful amount of raw mango kernels in Quail rations up to 10% (Joseph *et al*., 1997a). Mango is rich in tannins, tannins interferes with the bio availability of protein/efficiency of feed utilization. Processing methods such as fermentation, sun-drying, soaking, boiling, autoclaving etc results in reducing these anti-nutrients to a more tolerable level (Diarra and Usman, 2008; Abang *et al.,* 2016).

Japanese quails as an important animal source have caught the attention of scientists and researchers in the recent times (Edache *et al.,* 2005). Quails are highly prolific and hardy which make them adaptable to the tropical environment (Anon, 1991). They mature in about 6 weeks and are usually in full egg production by 50 days of age, with hen laying up to 200-300 eggs in their first year of lay (NRC, 1991; Smith, 2001). Their meat is lean and egg is low in cholesterol and this makes it desirable to people with coronary health concerns, their resistance to most pandemic poultry diseases, their ability to utilize greater amount of feed fiber, their small in size giving them the ability to thrive in a small cage which makes it suitable for back yard rearing, their relative short generation interval and low cost of production as they have lower feed requirement when compared to chicken (Garwood and Diehl, 1987; Mohammed, 2006; Okon *et al*., 2007; Odunsi *et al*., 2005; Tuluen and Dashe, 2013; Ojo *et al*., 2011).

This study was designed to investigate the effect of fermented mango kernel meal on the egg quality parameters of Japanese quails.

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^o 10' East and latitude 6^{o}8' North. The area is warm with a minimum temperature range of 29.8-35.6^{o}C. Rainfall is between 508-1016mm and relative humidity is 47-87% (Anon, 1995). 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 (AOAC, 2006).

Formulation of diets

Feeds were formulated to meet the nutritional requirements for quails during the laying 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.

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 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 each tier was ($1.0m^2$ x $0.78m^2$). Litter materials (wood shaving) 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 battery lantern for each tier 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 izal 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	47.00	45.10	42.80	40.50
FMKCM	0.00	5.00	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

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

Determination of egg quality parameters

Nine fresh eggs (Large, Medium and small) were separated from each treatment (3 eggs from each replicate) and used at weekly interval to determine egg quality parameters throughout the experimental period. The eggs were weighed using a sensitive electronic weighing balance scale to the nearest 0.01g and egg width and length were measured with a vernier caliper, egg was broken around the equator with care being taken to keep the yolk intact. Yolk was separated from the albumen using an egg separator and weighed separately. Egg shells were sun-dried for three days and their weights taken with the aid of a sensitive electronic balance. Shell thickness was measured using micrometer screw gauge. The measurements were taken from the pointed, middle and broad part of the egg and the mean thus obtained and measured to the nearest 0.01mm. Yolk height was taken with the aid of a spherometer at the highest point of its surface and yolk width was measured at long and short axis using vernier caliper and yolk color was carried out by visual comparism of the yolk with colour standards using the Roche yolk fan. The values obtained were used to calculate egg shape index and yolk index.

Egg shape index = Egg width/ Egg length x 100

Yolk index = Yolk height/ yolk width x 100

Statistical analysis

Data obtained were subjected to analysis of variance using GenStat statistical package (Genstat, 2005). Significant difference between treatments means were separated using Duncan's multiple range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The egg weight ranged between 9.42-10.23g. Results revealed that the egg weight of quails fed FMKCM were not significantly (P>0.05) influenced by the treatments. This range was higher than the 7.89-9.30g reported by Jika (2015). The result of the study showed that egg weight increase with increased levels of fermented mango kernel composite meal. Egg weights of quails fed 20% and 25% inclusion levels of fermented mango kernel meal had higher egg weight as compared to quails on other dietary treatments. Lin *et al*., 2004 indicated that egg weight can be used as criteria in assessment of nutritional status especially if they are obtained from bird of the same age, breed and health status. Similar results were reported in which egg weight increased significantly at higher levels of dietary protein inclusion Babangida and Ubosi (2013); Tuluen *et al*. (2013). Yamane (1979) indicated that a good quail egg should weigh about 9.30g and above. The egg shell weight ranged from 1.04-1.12g, this range was higher than 0.91-0.95 reported by Sachdev *et al*. (1975), 0.90-0.93 reported by Bawa *et al*. (2011) and 0.65-0.92 reported by Orayaga and Sheidi (2018). It could be as a result of the varying Ca: P ratio in the experimental diets of the various experiments. Egg Shell thickness ranged from 0.20-0.23mm. The results (0.24-0.27) were lower than that of Tuleun *et al*. (2013) and Bawa *et al*. (2011) (0.24-0.26mm). The result contradicts with the report of Roland *et al*. (1978). Who asserted that, shell thickness declines with age due to increase in egg size which forces the constant amount of shell to spread thinner and thus reducing the thickness and quality. However, it was in agreement with the report of Essien and Ekanem (1990) who asserted that, the amount of shell materials deposited per egg does not change with age and size. Yolk weight and albumen weight ranged from 3.21-3.42g and 5.20-5.49g respectively. The values recorded for albumen weight in this finding were different from those recorded by Sachdev *et al*. (1975) (4.42-4.60g) and Tuleun *et al*. (2013) (3.43-4.57). The results of the yolk weight was in agreement with the report of Essien and Ekanem (1990) who noted that, albumen weight is negatively correlated with yolk weight. This infers that eggs with higher values of albumin weight will have lower yolk weight. It was also in agreement with the reports of Fletcher *et al*. (1980) and Abang *et al*. (2015) who indicated that albumen weight was highly correlated with egg weight. The albumen weight is sufficient to measure egg quality as reported by Card and Neshiem (1972). Yolk weight and albumen weight of quails fed 20% and 25% inclusion levels of fermented mango kernel meal had higher weights than those of other treatments. The yolk index ranged from 0.47-0.49, the results was higher than 0.35-0.41 reported by Bawa *et al*. (2011) and 0.39-0.47 reported by Tuleun *et al*. (2013). Yolk index is the measure of the standing up quality of the yolk. Average values for fresh eggs usually fall between 0.40-0.50 as reported by Woolford (1985). The author further

Table 2: Egg Quality Characteristics of Japanese Quails Hens Fed Diets Containing Graded Levels of Fermented Mango Kernel Composite Meal

Parameters	(0%)	(10%)	(15%)	(20%)	(25%)	SEM	P-Value
External Characteristics							
Egg weight (g)	9.42	9.72	9.86	10.11	10.23	0.43	0.72
Egg length (cm)	3.00^{a}	3.01^{d}	3.03^{c}	3.04^{b}	3.05^{a}	0.03	0.04
Egg width (cm)	2.37^{b}	2.37^{b}	2.37^{b}	2.38^{a}	2.39^{a}	0.05	0.01
Shell weight (g)	1.04	1.07	1.09	1.10	1.12	0.06	0.08
Egg shell thickness (mm)	0.20^{b}	0.21^{b}	0.22^{ab}	0.22^{ab}	0.23^{a}	0.00	0.01
Egg shape index (%)	78.51^{b}	78.83^{b}	79.19^{b}	79.32^{b}	81.70^{a}	1.89	0.03
Internal Characteristics							
Albumen weight (g)	5.20	5.31	5.37	5.43	5.49	0.34	0.86
Albumen height (cm)	0.41	0.43	0.45	0.46	0.48	0.05	0.06
Yolk weight (g)	3.21	3.25	3.32	3.35	3.42	0.26	0.56
Yolk height (cm)	0.81^{b}	0.83^{b}	0.85^{b}	0.87^{a}	0.89^{a}	0.12	0.03
Yolk index (%)	0.47	0.47	0.48	0.48	0.49	0.02	0.95
Yolk color score	1.00	1.00	1.00	1.00	1.00	-	-

Mean with different superscripts (a, b, c, d,) within the same row differed significantly ($P<0.05$); SEM= Standard error of mean.

stated that, the yolk index of 0.25 or lower indicates the weakness of the yolk and extreme difficulties in handling it for measurement without breaking. In this finding, one could deduce that the yolk index of all the treatments were within the range and could be handled for measurement without scattering easily. Yolk color in laying hens is primarily determined by the content and profile of pigmenting carotenoids present in their feed (Hernandez *et al*., 2008). The yolk is one of the best indicators of the internal egg quality (Ayorinde, 1987) and is very important to consumers of the confectionary industry (Asuquo *et al*., 1992) and contributes much to the visual appeal of the egg.

Conclusions

From this study, it could be concluded that fermented mango kernel composite meal can replace maize up to 25% without compromising egg quality.

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