THE EFFECT OF FEEDING DIFFERENT LEVELS OF TIGER NUT (*Cyperus esculentus* L) SEED MEAL ON CARCASS AND ORGAN WEIGHTS CHARACTERISTICS OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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ABSTRACT
An investigation into the replacement value of tiger nut seed meal as substitute for maize in diets of Japanese quail was studied. Four different diets were formulated such that tiger nut replaced maize at 0% (T_1), 25% (T_2), 50% (T_3) and 75% (T_4) respectively in a Completely Randomized Design. The control diet (T_1) contained no tiger nut. Ninety six day-old Japanese quails were used for the experiment to determine the effect of the test diets on carcass and organ weights characteristics in a 49-days trial. The quail chicks were arranged into the 4 dietary treatments, each containing 3 replicates with 24 birds per dietary treatment and 8 birds per replicate. Result indicated that the carcass cut parts showed that liveweight, drumstick, thigh, shank, wings, head size and anus varied due to the influence of the dietary treatments, whereas, dressed weight, back, breast and neck were not affected by the diets. Drumstick and anal weights were reduced, whereas, thigh and head size increased with an increase in the level of tiger nut. The interaction of energy and protein levels of the diets did not affect dressed weight contrary to some previous findings. T_2 performed better in shank length (1.81%) and dressed weight (84.92%). T_3 was moderate in most performances. T_4 was least in shank (1.59%) and wing weights (6.99%). The organ proportions was influenced by the diets in liver/spleen, gizzard and intestinal weights, but showed no influence in kidney, heart and proventriculus weights. The dressed percent was highest in T_2 (84.92%). The liver weight was most significant in T_2 (3.50 % lwt). Gizzard size was highest in T_3 (4.67%) compared to the control (3.27%) and increases with high fiber diet. The gizzard and liver weights variation were attributed to the differences in the influence of dietary energy and protein interaction as well as fiber digestibility. The high value of the liver in T_2 favoured the internal organs. Based on the carcass cut parts and organ proportions, the 25 % level of inclusion of tiger nut is recommended for replacing maize.

INTRODUCTION
The increase in price of feed ingredients in developing countries has greatly reduced the rate of expansion in poultry industry (Ogunfowora, 1984), consequently the reflection on the quality and quantity of animal protein available in ever increasing population of Nigerians. Consequently, many farmers are either producing below capacity or are totally out of production (Agbabiaka *et al.*, 2013). Today, the focus in the monogastric livestock industry is on alternative feed stuffs, mostly those which can either substitute directly for cereals grains and or protein concentrates or can be included at a certain level to attain a comparable quality of production with the conventional ones, but must not be deleterious to animal health (Agbabiaka et al., 2012). The demand for protein of animal origin in a developing country like Nigeria has far outstripped the supplies. An average Nigerian for instance consumes only about 10 g per day of the minimum daily intake of 35 g recommended by Food and Agricultural Organization (FAO, 2003). This could be attributed to low level of animal protein production. To overcome some of these problems, attention of animal nutritionist must be focused on the utilization of lesser known unconventional feed stuffs that are readily available without stiff competition with human and agro allied industries such as tiger nuts (Agbabiaka, *et al.*, 2013). Tiger nut (*Cyperus esculentus* L.) is an edible perennial grass-like plant native to the Old World, and is a lesser-known vegetable that produces sweet nut-like tubers known as "earth almonds" (Cos¸kuner *et al.*, 2002). It is substitute for cow milk, flavouring agent for ice-cream and biscuit as reported by Temple *et al.*, (1990). Tiger nut is also known by various other names as chufa (in Spanish), earth nut, yellow nut sedge, groundnut, rush nut, and edible galingale (Oderinde and Tairu 1988). In Nigeria, the Hausa's call it "Ayaya", Yoruba's "ofio/imumu", the igbo's "aki Hausa" in Southern Nigeria. (Omode *et al.*, 1995). Tiger nut (*Cyperus esculentus*) is a non-conventional and under-utilized tuber belonging to the family *Cyperacae*. However, in many countries, *C. esculentus* is considered a weed (De Vries 1991) and it is underutilized (Adejuyitan 2011; Ukwuru and Ogbodo 2011). Tiger nut is not widely used in agriculture therefore, has been poorly investigated (Shikhov *et al*, 2011). The Japanese quail (*Coturnix*

coturnix japonica) which is now being bred for meat and eggs has the potential to serve as an excellent and cheap source of animal protein for Nigerians (Edache *et al.*, 2007). According to NRC (1994), quails are so precocious that they can lay eggs when they are five weeks old, and it is said that about twenty of them are sufficient to keep an average family in eggs all year round. The quail meat is renowned for its low caloric value in addition to having high quality protein of high biological value (Haruna *et al.*, 1997). This study was therefore designed to determine the dietary effect of tiger nut meal as replacement for maize on the carcass and organ weights characteristics of japanese quails.

MATERIALS AND METHODS

Site and Duration of Study

This experiment was conducted at the Poultry Unit of Teaching and Research Farm, College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike. Umudike is located on latitude $5^0 29^1$N and longitude $7^0 321$E in the Rain Forest Zone of Nigeria. This site has a mean daily temperature of between 27^0c and 35^0c throughout the year and an average rainfall of 2000mm per annum (NRCRI 2003).

Experimental Diet

The tiger nut seed was sun dried for seven (7) days and pass through a hammer mill to produce tiger nut seed meal. The drying process reduced excess moisture so as to prevent rancidity of the material and growth of moulds. Five experimental diets were formulated such that tiger nut replaced maize at 0%, 25%, 50% and 75% dietary levels respectively. Other ingredients were similar in all the diets.

Experimental Birds and Design

Ninety six (96) day old quails were used for the study which lasted for forty nine (49) days. The birds were reared in a deep litter system whose floor was covered with wood shavings and were fed and water provided *ad libitum* throughout the experimental period. Also standard management practices were strictly observed. The quail chicks were randomly allocated to four (4) dietary treatments replicated three times, with each replicate having eight (8) birds in a Completely Randomized Design (CRD).

Source and Processing of Tiger Nut Seedmeal

The tiger nut for this study was purchased from Ubani market, Umuahia. The tiger nut was sun dried for 7 days and passed through a hammer mill to produce tiger nut meal. Proximate analysis was done with a sample of tiger nut meal. The tiger nut meal was further subjected to phytochemical analysis for anti-nutritional inhibitors using standard methods.

Data Collection

The quail birds were weighed at the beginning of the experiment and subsequently on weekly basis. At the end (7^{th} week) of the experiment, two birds were randomly selected from each replicate and feed were withdrawn the night before the day of termination. Fasting improves carcass quality by elimination of faeces and unabsorbed nutrients which might support bacterial growth. The live weights of the birds for carcass analysis were taken, slaughtered and allowed to bleed. The weights of the dressed birds were taken, thereafter the body parts were severed and separated from each carcass in order to obtain the carcass yield. The cuts were made close to the body line. Dissected parts that were weighed and recorded includes: the head, thigh, breast, drum-stick, wing, shank and neck. Internal organs such as crop, proventiculus, gizzard, spleen, heart, liver, kidney, pancreas, lungs, caecum and duodenum were also separated, weighed using a digital scale and recorded. Data collected were imputed and subjected to Analysis of Variance (ANOVA). Difference between means was separated using Duncan Multiple Range Test (Duncan, 1980).

RESULTS AND DISCUSSION

The impact of dietary treatments on carcass cut parts (expressed per % live weight) of Japanese quail based on different levels of tiger nut as a replacement for maize is presented in table 3. Significant differences ($p<0.05$) were observed among the treatments in live weight, drumstick, thigh, shank, wings, head and anus. T_4 and the control (T_1) were the most significant in live weight, followed by T_3 and lastly, T_2. The control outperformed the other treatment groups in drumstick and anus weights. This suggests that tiger nut inclusion reduces the anal and drum stick size. The test diets outperformed the control diet in thigh and head values, suggesting that tiger nut increases the thigh and head size. T_2 was the most significant ($p<0.05$) in shank weight, whereas, T_4 was the least. Similarly, T_2 and T_1 were the most significant ($p<0.05$) in wing weight, whereas, T_4 was the least. No significant differences ($p>0.05$) were observed in dressed weight, back, breast and neck among the treatment groups. This non significance suggests that tiger nut replacement of maize at 25, 50 and 75 % levels has no effect on these parameters in Japanese quail. Compared to the control, the result of this experiment shows that tiger nut replacement of maize at varying levels reduced the following parameters: live weight (except in T_4), drumstick, wing weight (except in T_2), and anal weight, and increased the thigh, shank (except in T_4) and head size. Though T_2 recorded the least live weight, but the details of the cut parts of T_2 in relation to live weight shows that T_2 to some extent performed better than T_3 and T_4. This is revealed in its high significant values in most parameters including shank, wings and head. T_2 equally showed higher potentials though not statistically significant in the following parameters: dressed weight, drumstick, breast and neck compared to T_3 and T_4. The optimum replacement level of maize with tiger nut on carcass yield in this present study was 50 % (T_3) as the T_4, though it had very similar performance with the other two test diets, yielded lower shank and wing weights. Sezai *et al.* (2013) observed that age and sex had a significant effect on carcass weight and carcass yield. The dietary effect on the organ proportions (expressed per % live weight) of Japanese quail based on different levels of tiger nut as a replacement for maize is presented in table 4. Of the three organs liver, heart and gizzard that make up the giblet, only the liver and gizzard showed significant difference in this study suggesting possible effect of different dietary protein and energy compositions as previous researches have established. Significant differences ($p<0.05$) were observed in liver, spleen, gizzard and intestine, whereas, no significant difference ($p>0.05$) was observed in kidney, heart and proventriculus. T_2 recorded the most significant value for liver, spleen and intestine. T_3 and T_4 compared with the control in liver, spleen, whereas, for intestine, only T_3 compared with the control while T_4 was lower than the control. T_3 recorded the highest ($p<0.05$) gizzard value followed by T_2 which is higher than the control, whereas, T_4 was the least. Higher gizzard size, liver and intestinal weights may have encouraged more efficient digestion. T_2 and T_3 are deduced to be more favoured in organ proportions than T_4. Bonos *et al.* (2010) made similar observation when they studied the effect of supplementation of the prebiotic, mannan oligosaccharides (MOS), the acidifier, calcium propionate (CPr) or their combination in the feed of Japanese quail (*Coturnix japonica*). Tuluen *et al.* (2009) observed that the percent live weight of the visceral organs (liver, pancreas, heart, gizzard) were statistically comparable ($p>0.05$) with the corresponding visceral organs weights in the control diet of Japanese quails. The value obtained for heart was higher than the values reported by them; the liver weight in this study are higher than their values except T_4 which conforms with their report; the value for full gizzard conforms with the range of values obtained in this work for the gizzard.

Conclusion

This study has demonstrated that tiger nut can replace maize at levels that ranges from 25 % but less than 50% for better carcass and organ proportions. The 33 % level established in broilers by previous researchers can be attempted in Japanese quail. Further research should consider partitioning gender, energy and protein levels for more precise results. Treating the raw tiger nut in order to attenuate the possible effects of anti-nutrients is also recommended.

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Table 1: Ingredient Composition of the Experimental Diets Fed Japanese Quails: Replacement Levels of Tiger nut Seed meal

Ingredients	T_1 0%	T_2 25%	T_3 50%	T_4 75%
Maize	48.00	36.00	24.00	12.00
Tiger nut meal	0.00	12.00	24.00	36.00
Soybean meal	25.00	25.00	25.00	25.00
Fish meal	3.00	3.00	3.00	3.00
Wheat Offal	8.00	8.00	8.00	8.00
Palm Kernel cake	12.00	12.00	12.00	12.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Vit-min.premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Crude Protein (%)	22.03	22.23	22.41	22.09
ME (Kcal/kg)	3034	3036	3038	3040

Table 2. Proximate Composition of Experimental Diet Containing Different Inclusion Levels of the Tiger Nut Seed Meal

Parameters	T1	T2	T3	T4	SEM
	0%	25%	50%	75%	
Dry matter (%)	94.97	93.50	93.47	95.60	2.25
Moisture content (%)	5.03	6.50	6.53	4.40	0.61
Ash (%)	8.90	9.20	9.20	9.03	0.86
Crude protein (%)	22.05	21.29	20.08	20.58	2.21
Crude fiber (%)	7.81	8.56	8.79	8.86	1.24
Crude Fat	5.45	5.98	6.08	6.20	1.15
Nitrogen free extract	42.20	42.59	42.16	38.86	2.58

a,b,c Means with different superscripts are significantly different at $p<0.05$; SEM – Standard error of the mean

Table 3: Carcass cut parts (expressed per % live weight) of Japanese quail based on different levels of tiger nut as a replacement for maize

Cut parts	T_1	T_2	T_3	T_4	SEM
	0%	25%	50%	75%	
Live weight (g)	130.00^a	120.00^b	128.67^{ab}	133.33^a	1.90
Dressed weight %	84.14	84.92	78.55	79.34	1.63
Drumstick (%)	9.29^a	6.55^b	6.32^b	6.11^b	0.40
Thigh (%)	6.61^b	8.77^a	8.79^a	9.49^a	0.35
Shank (%)	1.64^{ab}	1.81^a	1.74^{ab}	1.59^b	0.03
Back (%)	12.69	13.08	13.20	14.52	0.32
Breast (%)	25.22	24.49	23.39	23.12	0.38
Wings (%)	8.71^a	8.33^a	7.80^b	6.99^c	0.20
Head (%)	3.93^b	4.66^a	4.58^a	4.22^{ab}	0.12
Neck (%)	3.94	4.18	4.14	4.09	0.09
Anus (%)	4.17^a	3.28^b	2.89^b	2.93^b	0.17

a,b,c Means with different superscripts across the rows are significantly different at $p<0.05$;
SEM- Standard error of the mean.

Table 4: Organ proportions (expressed per % liveweight) of Japanese quail based on different levels of tiger nut as a replacement for maize

Internal organs	T_1	T_2	T_3	T_4	SEM
	0%	25%	50%	75%	
Liver+spleen (%)	2.56^b	3.50^a	2.56^b	2.04^b	0.18
Kidney (%)	2.85	2.99	2.88	3.00	0.05
Gizzard (%)	3.27^c	4.07^b	4.67^a	3.40^c	0.18
Heart (%)	0.93	0.97	0.99	0.95	0.02
Proventriculus (%)	0.95	0.92	0.98	1.00	0.02
Intestine (%)	5.24^b	6.16^a	5.42^b	3.79^c	0.27

a,b,c Means with different superscripts across the rows are significantly different at $p<0.05$; SEM- Standard error of the mean.