

## Nutritional and Economical Evaluation of Sandbox (*Hura crepitans*) Seed Meal-Based Diets for Growing Japanese Quails (*Coturnix coturnix japonica*).

<sup>1</sup>Ukoha, O.A., <sup>2</sup>Nsa, E. E., <sup>3</sup>Ekpenyong, U. U.

<sup>1</sup>Department of animal nutrition and forage science, College of Animal science and animal production, Michael Okpara University of Agriculture, Umudike

<sup>2</sup>Faculty of animal science, University of Calabar

**Target Audience:** academic researchers, Poultry farmers, extension workers

### Abstract

Three hundred, two weeks old quails (100 males and 200 females) were randomly allocated to five grower diets designated T1, T2, T3, T4 and T5 containing 0, 25, 50, 75 and 100% of sandbox seed meal (SBSM) as a replacement for soy bean meal respectively in a completely randomized design experiment. Each treatment was replicated 4 times with 15 birds per replicate (5 males and 10 females). The proximate composition result showed that sandbox meal contained 30.56% protein, 15.99% ether extract, 12% crude fiber and 3.59% Ash (3.59%). All the mineral elements apart from calcium and iron were significantly ( $p < 0.05$ ) higher in soybean meal than in sandbox seed meal. Final weight, daily weight gain and feed conversion ratio depreciated ( $P < 0.05$ ) as the level of sandbox increased to 75%. Feed cost/kg and total feed cost consumed (N) significantly ( $p < 0.05$ ) decreased as replacement level of soya bean meal with sandbox increased in the diets. Nutrient digestibility showed non-significant ( $p > 0.05$ ) differences. Serum biochemical parameters except total protein and uric acid indicated non-significant ( $p > 0.05$ ) differences. In conclusion, sandbox seed meal could replace up to 75% of soya bean meal in growing Japanese quail diet without deleterious effect on the growth and health of quails.

**Keywords:** Japanese quails, sandbox seed meal, growth performance, serum chemistry, nutrient retention, nutrient digestibility

### Description of Problem

The Japanese quail (*Coturnix coturnix japonica*) is slowly gaining prominence in poultry industry (1). It is suited for commercial rearing for eggs and meat production under intensive management system. This is because of their hardiness and ability to thrive in small cages (2), and the relative short time and cheaper cost of

production (3).

Their small size, rapid growth rate and early onset of egg production enable the establishment of a quail enterprise at a low capital outlay. Also, its ability to produce 3 to 4 generations per year, makes it an interesting laboratory animal (4). Furthermore, quails have lower feed requirements compared to chickens, can be reared anywhere and

consumes as low as 20-30g of feed per day (5).

Despite the great potential of quail production in Nigeria, uncontrolled increase in prices of conventional feed ingredients such as maize, soya beans and groundnuts which serve as the principal sources of energy and protein has increased the cost of production of quail birds. The effects of these challenges have been a major discussion among poultry farmers which have reflected on the quality and quantity of animal protein available for human consumption (1). With these commodities becoming scarce and consequently expensive as a result of high demand by man and his industry, there is therefore, the need to pay attention to the exploitation of other non-conventional protein and energy sources, mostly those that are not only indigenous, can be cultivated in the tropical environment but not directly consumed by humans (6).

The tree *Hura crepitans* is a shade tree with thorny trunk, high protein and oil contents, commonly found on roadsides and villages in Nigeria. (7)

The dry matter of the seed (91-95%) is quite comparable to those of the conventional feedstuff. It is also a quite good indicator of a long shelf life of the seed. The crude protein content of 30% is lower than that of soybean and groundnut but has amino acid levels that is comparable to other conventional feedstuffs (7).

It is apparent that decorticated sandbox seed has a place in quail's diet. This study was designed to evaluate the nutritive value of sandbox (*Hura crepitans*) seed meal in the diets of Japanese quails.

## Materials and Methods

### Study location

The experiment was conducted at the Jen Farms, Ikot Ansa, Calabar. Cross River State, Nigeria. Calabar is located within the tropical rain forest Zone of Nigeria, it lies between latitude 4°5'N and 15°39'N of the Equator and longitude 8°17'E and 10°45'E of the Greenwich Meridian. It has an average relative humidity of 88% with an average yearly rainfall of 3,076mm (121.1inches) within average yearly raining days of 173 (8).

### Collection and processing of sandbox seed meal.

The matured sandbox seeds were harvested from pods of sandbox trees within Calabar Metropolis. The pods were broken with sticks and the seeds sun-dried for 3 days and thereafter, oven-dried at 60°C (SAISHO S-196 model hot oven) before being milled using a meadows model 35 hammer mill and sieved through a mesh of 5mm. Oil was extracted from the seed through mechanical means as described by (6).

The samples were then stacked in sack bags for subsequent analyses and incorporation into the diets. All analyses except for nitrogen of droppings were on dried samples. Proximate, mineral and anti-nutritional composition were determined according to (9). The Metabolizable energy was calculated according to the procedure of (10) as:  $ME (Kcal/KgDM) = 37 \times \%Protein + 81.8 \times \%Fat + 35.5 \times NFE$ .

### Experimental animals

Three hundred one week old quails (100 males and 200 females) having similar average weight were selected from a flock of quails bought at day old from the National Veterinary Research Institute Vom, Plateau

State, Nigeria. The selection of males and females was done based on plumage differences using breast coloration (Which was reddish-brown, with speckled pattern in males). They were housed in an open-sided poultry deep litter house with asbestos roofing sheet. Two weeks before the commencement of the trial, the pens were washed, disinfected and fumigated with formalin. The quails were fed twice a day (8.00 hours and 16.00 hours). Feed and fresh drinking water was provided *ad libitum* throughout the experimental period while routine management practices were carried out. This experiment lasted for 4 weeks.

**Experimental diets**

Five experimental layer diets were formulated to contain (0, 25, 50, 75 and 100%) of sandbox seed meal to replace soybean meal and designated T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> respectively as shown in Table 1 to provide the required nutrients of growing Japanese quails ration according to (12) recommendations. The quails were fed a known quantity of feed between 0.7:00 to 08:00am and also in the evening 16:00 to 17:00pm hours daily.

**Table 1. Dietary composition of sandbox seed meal-based Japanese quail grower diets**

<b>Ingredient</b>	<b>T<sub>1</sub> (0%)</b>	<b>T<sub>2</sub> (25%)</b>	<b>T<sub>3</sub> (50%)</b>	<b>T<sub>4</sub> (75%)</b>	<b>T<sub>5</sub> (100%)</b>
Maize	47.70	47.70	47.70	47.70	47.70
SBSM	0.00	9.00	18.00	27.00	36.00
Wheat offal	5.00	5.00	5.00	5.00	5.00
PKC	3.50	3.50	3.50	3.50	3.50
SBM	36.00	27.00	18.00	9.00	0.00
Fish meal	3.50	3.50	3.50	3.50	3.50
Bone meal	2.50	2.50	2.50	2.50	2.50
Oyster shell	1.00	1.00	1.00	1.00	1.00
Salt	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
V/min premix	0.20	0.20	0.20	0.20	0.20
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

<b>Calculated composition %</b>					
Crude protein	25.66	25.31	24.85	24.48	24.11
Crude fibre	4.21	4.73	4.90	5.14	5.29
ME(Kcal/Kg)	2602.22	2616.18	2626.41	2658.00	2651.02
<b>Analysed Values %DM</b>					
Crude protein	24.90	24.79	24.47	24.27	24.09
Crude fibre	4.11	4.34	4.49	4.97	5.23
Ether extract	3.45	3.98	4.43	4.95	5.09
ME(Kcal/kg)	2897.22	2900.87	2915.76	2928.43	2931.92

Vit/min premix provided the following per kg of feed, vit A: 3,400.00 i.u, vit D: 600,000.00 I.u., vit E: 4,000.00mg; vit K: 400.00mg, niacin: 6,000.00mg, vit B2; 1,800.00mg, vit B6 1,200.00mg, vit B12: 600mg, panthothenic acid: 1800.00mg, choline chloride: 70,000.00mg, cobalt: 80,000.00mg, copper: 1200.00mg, iodine: 400.00mg, iron; 8,000.00mg, manganese; 16,000.00mg, selenium: 80.00mg, zinc; 12,000.00mg

#### Data collection

Feed intake by the quails were noted daily. The initial weights of the quails were taken at the start of the experiment and thereafter on a weekly basis. Weight gain was obtained by subtracting the initial weight from the final weight.

Daily feed intake (g/bird/day) = quantity of feed given (g) – left over of feed (g)/ no of birds x 28 days

Daily weight gain (g/bird/day) = Final Live weight – Initial weight/ Number of birds x 28 days

Feed Conversion Ratio = Quantity of Feed Consumed/ Weight gain

Protein Intake =  $\frac{\text{Crude Protein content of the diet} \times \text{Quantity of Feed Consumed}}{100}$

Protein Efficiency = Weight gain/Protein Intake.

#### Digestibility Trial

Twenty birds per treatment (1 male quail per replicate) were randomly selected at the end of the 28 days of feeding the experimental diets and housed in a previously disinfected two-tier wire floor metabolic cages of dimension of 0.2m x 0.2m floor spacing per pen and a dropping tray inserted for easy collection of fecal droppings. After the initial five days of acclimatization, birds were fed

*ad libitum* with a known quantity of the experimental diets in the morning, after which the left overs were weighed. Daily voluntary feed intake was measured and recorded. Their droppings were collected and weighed fresh, then they were dried using a GallenKamp® oven at 80°C for about 48hours to obtain a constant weight, and ground to pass through a standard 0.02mm sieve for proximate composition

determination (9).

Apparent digestibility (%) =  $\frac{\text{Nutrient in feed} - \text{Nutrient in faeces} \times 100}{\text{Nutrient in feed}}$ .

#### Serum chemistry

At the end of the 28 days of feeding the experimental diets, 2 male quails per replicate were further selected for blood analysis. Blood samples were collected from the veins of the wing's web with the use of hypodermic syringe into a clean test tube, devoid of the anticoagulant and used in the determination of serum biochemical parameters. Serum enzymes: Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) activities were determined using spectrophotometric method. The serum alkaline phosphate (ALP) activities were determined by the phtalein micros phosphate method. Total serum proteins were determined by the direct Biuret method as described by (9) and the serum albumin, globulin and cholesterol was determined as outlined by (13). Serum electrolytes: Sodium, potassium, chloride and bicarbonate were estimated using flame photometer (9).

#### Experimental Design and Data analysis.

Completely Randomized Design experiment was used with the following model:

$$\text{Model } Y_{ij} = \mu + T_i + E_{ij}$$

Where;

$Y_{ij}$  = Individual observation

$\mu$  = Population means

$T_i$  = Treatment effect

Data were subjected to analysis of variance using SPSS 20 (10) and significant difference among the means were tested by Duncan's Multiple Range Test (11).

#### Results and Discussion

The proximate composition of sandbox seed meal and soya bean meal as represented in Table 2 showed that, sand box seed meal is lower in crude protein (30.56%) than soybean meal (42.64%), but when compared to other legumes; they are higher than jack bean (27.75%), Kidney bean (22.40%) and cowpea (27.75%) as was reported by (14). This makes it a more desirable alternative vegetable protein source than most other legumes. The ether extract of sandbox seed meal (15.99%) was far higher than that of soy bean meal (5.04%) and comparable with that of African locust (20.30%) and groundnut seed (27.89%) as revealed by (15). The result reveals that sandbox seed is rich in ether extract, which could be exploited in the manufacturing of edible oil for human use, making it also a good source of energy in both poultry and livestock rations.

The fibre content of sandbox seed meal (12.00%) was higher than that of soybean meal (3.90%) and seems to be higher than the values reported for most grains like African locust bean (8.82%) and jack bean (7.80%) according to (16). However, a level of fibre is needed in livestock diets to facilitate digestion.

Ash content of the sandbox seed (3.59%) was low when compared to soya bean meal (6.77%), indicating the need for mineral supplementation when used in large amount in diets (17).

The metabolizable energy of sandbox seed meal (3205.27Kcal/Kg) was higher than that of soybean meal (3001.27Kcal/Kg). This could be due to the high oil content in sandbox seed meal. Oil has been a major source of boosting the energy content of feeds. It has been used by many feed formulators to augment the energy in low

energy rations (17). The mineral and anti-nutritional contents of sandbox seed meal and soybean meal are shown in table 3. All the mineral element apart from calcium and iron were significantly ( $p<0.05$ ) higher in soy bean

meal than in sandbox seed meal. Among the anti-nutritional factors, saponin had the highest value (12.96mg/100g), followed by phytic acid (11.65mg/100g) which agrees with the findings of (17).

**Table 2. Proximate composition of sandbox seed meal and soy bean meal**

Proximate composition (%)	Sandbox seed meal	Soy bean meal	SEM
Dry matter	89.36±0.66	89.36+/-0.73	0.010 <sup>NS</sup>
Crude protein	30.56+/-0.65	42.64+/-0.62	0.654*
Ether extract	15.99+/-0.61	5.04+/-0.43	0.243*
Crude fiber	12.00+/-0.51	3.90+/-0.63	0.445*
Nitrogen extract	37.86+/-0.81	41.65+/-4.11	0.004 <sup>NS</sup>
ME(Kcal/Kg)	3205.21+/-0.98	3001.27+/-0.78	0.427*

**Table 3. Mineral and anti-nutritional composition of sandbox seed meal and soy bean meal**

Mineral elements	Sandbox seed meal	Soybean meal	SEM
Calcium	1.21+0.02	0.65+0.01	0.010*
Phosphorus	0.78+0.01	0.95+0.030	0.435)
Magnesium	0.44+0.03	0.60+0.04	0.765*
Potassium	0.35_0.06	0.94+0.01	0.417*
Sodium	0.34+0.04	0.77+0.03	0.328*
Manganese(mg/Kg)	28.99+0.27	39.80+1.7	0.479*
Iron(mg/Kg)	109.33	67.39+2.71	0.730*
Copper(mg/kg)	3.00+0.67	11.12+1.84	0.539*
Zinc(mg/Kg)	28.39+2.08	29.09+1.10	0.004 <sup>NS</sup>
<b>Anti-nutritional factor (mg/100g)</b>			
Tannin	0.41+0.51	0.03+0.01	0.916*
Saponin	11.99+0.51	1.88+0.02	0.783*
Phytic acid	11.94	0.49+0.34	0.451*
Trypsin inhibitor	2.02+0.02	0.04+0.01	0.413*
Oxalate	5.03+0.07	0.06+0.01	0.225*

\*( $p<0.05$ ) NS Non significant

**Growth Performance of Japanese quails fed diets containing sandbox seed meal as a replacement for soybean meal**

Growth performance characteristics of Japanese quails fed sandbox seed based diets is presented in table 4. Significant ( $P<0.05$ ) differences were observed among treatment means of evaluated parameters such as final live weight, daily weight gain, feed conversion ratio, protein intake and protein efficiency. Birds fed diet 3 (50% sandbox seed meal (SBSM) as replacement for soybean meal had the highest ( $P<0.05$ ) live body weight 146.70g which were not different from birds on the control diet T<sub>1</sub> and diet 2. The daily weight gain followed the same pattern with birds on diets 2 and 3

expressing statistically ( $P<0.05$ ) similar values that were significantly ( $P<0.05$ ) than the control T<sub>1</sub>, T<sub>4</sub> and T<sub>5</sub> in that order. This observation could be due to the nutrient and anti-nutritional components of the diets at these levels. At 75% and 100% replacement of soya bean meal with sandbox seed meal, there must have been a build-up of anti-nutrient as seen in table 2. Likewise the fibre components of the diets. Similar observations had been made by (18) on pigs fed on pea (19).

There were no significant difference in the feed conversion ratio for all the treatments except diet 5, which had the least significant ( $P<0.05$ ) feed conversion ratio.

**Table 4. Growth performance characteristics of Japanese quails fed sandbox seed meal-based diets and feed cost.**

Parameters	Replacement levels of soybean meal with sandbox seed meal					SEM
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	
I.W(g)	54.50	54.55	54.59	54.30	54.51	2.90
F.W(g)	142.45 <sup>a</sup>	145.00 <sup>a</sup>	146.70 <sup>a</sup>	140.08 <sup>a</sup>	130.60 <sup>b</sup>	5.80
D.W.G g)	2.52 <sup>a</sup>	2.58 <sup>a</sup>	2.63 <sup>a</sup>	2.45 <sup>a</sup>	2.17 <sup>b</sup>	0.11
D.F.I (g)	16.09	16.12	16.18	16.20	16.00	2.00
F.C.R	6.38 <sup>b</sup>	6.25 <sup>b</sup>	6.15 <sup>b</sup>	6.61 <sup>b</sup>	7.37 <sup>a</sup>	0.17
P.I (g)	3.99	3.97	3.96	3.92	3.85	0.30
P.E.R	0.63	0.65	0.66	0.63	0.64	0.07
Mortality (%)	0.00	0.00	0.05	0.06	0.00	

<sup>abcde</sup> means within the same row with different superscript are significantly different from one another ( $p<0.05$ ). I.W, F.W, G.W.G, D.F.I, F.C.R, represent initial weight, final weight, daily feed intake, feed conversion ratio, protein intake and protein efficiency ratio respectively. SEM=standard error of mean.

**Feed cost analysis of sandbox seed meal in japanese quail grower diet**

Table 5 represents the feed cost analysis of sandbox seed meal based diet for growing

Japanese quails. There were significant differences ( $P<0.05$ ) in the cost/kg feed and cost of total feed consumed by the quails in all the treatments. Cost per kilogram feed

decreased as the level of inclusion of the sandbox seed meal increased in the diet. A kilogram of diet 1,2,3,4 and 5 cost N215.00, N200.00, N195.00, N190.00 and N184.00 respectively. Similar trend was observed in

the cost of total feed consumed. This is an indication that sandbox seed meal has the potential of reducing feed cost and the cost of production of quail birds at the long run.

**Table 5. Feed Cost of quail grower diet containing sandbox seed meal**

Parameters (%)	Replacement levels of soya bean meal with sandbox seed meal					SEM
	T <sub>1</sub> (0%)	T <sub>2</sub> (25%)	T <sub>3</sub> (50%)	T <sub>4</sub> (75%)	T <sub>5</sub> (100%)	
Cost/kg (₦)	215.80 <sup>a</sup>	200.08 <sup>b</sup>	195.10 <sup>c</sup>	190.00 <sup>d</sup>	184.90 <sup>e</sup>	4.07
Cost of feed consumed (₦)	121.80 <sup>a</sup>	112.89 <sup>ab</sup>	110.49 <sup>ab</sup>	107.73 <sup>ab</sup>	103.54 <sup>b</sup>	11.08

**Nutrient digestibility of growing Japanese quails fed diets containing sandbox seed meal**

There were no significant  $P < 0.05$  differences observed in the energy digestibility at all the treatment levels. This means that, there was no disparity in the utilization of the diets containing sandbox seed meal at all the various treatment levels.

(17) reported non-significant differences in the retention of proximate components and energy in broiler birds fed finisher diets containing sandbox seed meal. It could indicate that sandbox seed meal can replace up to 100% of soya bean meal without significant depression effect on the nutrient metabolism of Japanese quails.

**Table 6. Nutrient Digestibility of growing Japanese quails fed sandbox seed meal-based diets.**

Parameters (%)	Replacement levels of soya bean meal with sandbox seed meal					SEM
	T <sub>1</sub> (0%)	T <sub>2</sub> (25%)	T <sub>3</sub> (50%)	T <sub>4</sub> (75%)	T <sub>5</sub> (100%)	
Dry matter	88.23	88.01	87.89	87.71	87.36	5.98
Crude protein	35.30	36.00	35.41	32.76	31.70	3.81
Crude fibre	27.27	27.26	27.02	26.73	24.15	3.45
Ether extract	41.00	45.03	47.30	40.42	31.66	1.15
Ash	21.73	21.05	18.44	16.55	16.32	2.67
N.F.E	69.50	67.31	67.22	61.52	60.06	7.79
ME(Kcal/Kg)	2880.45	2886.10	2896.00	2901.45	2920.50	11.60

N.F.E represents nitrogen free extract

**Serum chemistry of Japanese quails fed sandbox seed-based diets**

Serum chemistry of japede quails fed sandbox seed meal-based diets are summarized in table 7. Among the serum parameters, only the total protein and uric acids showed significant ( $P<0.05$ ) differences across the treatment means. Serum total protein values were significantly ( $P<0.05$ ) higher in D<sub>1</sub> (3.42g/dl) and D<sub>2</sub> (3.40g/dl), then lower in D<sub>3</sub> (3.11g/dl), D<sub>4</sub> (3.09g/dl) and D<sub>5</sub> (2.79g/dl). At 100% replacement level of soya bean meal with sandbox seed meal, serum uric acid concentration of birds was the least ( $P<0.05$ ). The decreased serum total protein at 100% replacement level with corresponding decrease in serum uric acid might be an indication of resultant effect of reduced protein utilization with increasing level of

sandbox seed meal. According to (20), where there is efficient energy or protein utilization, the concentration of serum uric acid is normally decreased as a result of low deamination. However, the range was within the range recommended by (20) for a healthy bird. This observation showed that the protein level in the diet was sufficient to sustain or support the normal protein levels in the blood.

Creatinine values across the treatment groups showed non-significant ( $P<0.05$ ) differences and were within the norming range for a healthy bird as reported by (21). This observation implies that sandbox seed meal did not affect activities in the kidney of the birds. And normal physiological activities were not affected as a result of feeding the animal the test ingredient.

**Table 7. Serum chemistry of Japanese quails fed sandbox seed-based diets**

Parameters	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
AST(IU/L)	61.89	60.32	51.90	57.92	68.32	5.44
ALT (IU/L)	23.31	22.21	19.41	18.54	17.09	1.11
AP(IU/L)	107.11	98.43	101.31	98.65	103.93	8.93
Total protein (g/dl)	3.42 <sup>a</sup>	3.40 <sup>a</sup>	3.11 <sup>b</sup>	3.09 <sup>b</sup>	2.79 <sup>c</sup>	0.01
albumin (g/dl)	1.66	1.60	1.59	1.51	1.49	0.03
Globulin (g/dl)	1.76	1.80	1.52	1.51	1.30	0.02
A/G ratio	0.94	0.88	1.05	0.96	1.15	0.01
cholesterol (mg/dl)	78.71	80.34	81.87	81.90	96.54	6.73
Total bilirubin (mg/dl)	2.11	2.11	2.16	2.04	1.98	0.02
Uric acid (mg/dl)	5.66 <sup>a</sup>	5.61 <sup>a</sup>	5.19 <sup>b</sup>	5.00 <sup>b</sup>	3.72	0.65
Creatinine (mg/dl)	0.42	0.36	0.30	0.24	0.21	0.09
Urea (mmol/L)	3.30					
Chorine iron (mmol/L)	15.88	13.77	13.09	12.20	12.00	1.88
Potassium ion (mg/dl)	3.85	3.68	4.10	3.12	3.09	0.46
Bicarbonate (umol/L)	22.67	20.42	18.65	23.09	25.04	1.99
Sodium ion (umol/L)	139.50	140.43	140.43	124.93	122.04	4.92

<sup>abc</sup> means within the same row with different superscript are significantly different from one another ( $p<0.05$ ), A/G = albumin and globulin

**Conclusion**

From the results, sandbox seed meal is a promising protein feedstuff. The replacement of soybean meal with sandbox seed meal up to 75% could improve growth performance of Japanese quail birds without its health status being compromised.

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