

of feed. It is therefore necessary to look for unconventional feedstuffs which are available, cheap, safe and nutritionally adequate to substitute for maize in livestock feeding.

Mango (*Mangifera indica* L) kernel, a by-product of mango pulp is reported to be a good source of starch [3], which makes it a rich source of carbohydrate, protein, fat, fibre, mineral, calcium and phosphorus depending on the variety. Research in the past have indicated the suitability of mango seed kernel in livestock feeding but the level of inclusion in poultry diets has been low because of the presence of tannins which have been reported to inhibit chicks' growth [4;5]. Hence, the need to assay for blood parameters (Haematology and Serum Biochemistry) which are good indicator of the health status of the animals becomes necessary [6].

Japanese quails are hardy birds that thrive in small cages. It is this attribute of hardiness, ability to withstand diversified agro-climatic conditions and inexpensive to keep that makes it viable commercial poultry enterprise. Japanese quails mature in about 6 weeks and are usually into full egg production by 50 days of age. With proper care, hens should lay 200 eggs in their first year of lay. Life expectancy is only 2 to 2½ years [7]. These attributes makes it an ideal experimental bird for the provision of supplemental income and protein. The objective of this study is to determine the effect of sun dried mango kernel meal (SMKM) on serum biochemical composition of laying Japanese quail (*Coturnix coturnix japonica*).

Materials and methods

A total of one hundred and forty four (144) three weeks old unsexed Japanese quails with average body weight of about 28g were studied over a period of nine weeks. The birds were raised in the poultry unit of Animal science Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State. Quails were randomly allotted to three dietary treatments (I –III) of forty eight quails each. Each treatment was replicated thrice with sixteen quails per replicate. In each of the three diets, sun-dried mango kernel meal (SMKM) replaced maize at 0%, 25% and 50% as treatments I, II and III respectively. The experimental birds were managed intensively in cages of three tiers. Each tier was separated by wood. Wire mesh was used for the walls and doors to allow adequate ventilation and lighting. The dimension of each tier was 1.00m² X 0.78m². Litter materials (wood shavings) were used on the wooden floors. Each tier was equipped with adequate drinkers and feeding troughs. A floor space of 0.007m² to 0.009m² per quail was provided. Artificial lighting was provided by

means of a 200 watts bulb in each tier to ensure adequate feed intake. Feeds were weighed with a micro scale balance of 2kg before serving to ensure a uniform amount across treatments. Quails were served 200g of feed per replicate for the first week at about 8:00am on a daily basis; the quantity was increased by 50g on weekly basis. Fresh water was supplied daily *ad-libitum*. Drinkers and feeders were washed and disinfected with izaral when appropriate. At the end of the experiment (9th week), two (2) laying quails per treatment were randomly selected and weighed. Quails were slaughtered by cutting of the jugular vein with sharp knife. The blood samples were collected at slaughter into sterile vacutainers and the Serum was separated by centrifuge at 750g for 15 minutes and stored in a deep freezer until time of use for Serum biochemical analysis. Serum biochemical indices were carried out using routine standard clinical chemistry procedures [8].

Table 1: Composition of diet with sun-dried mango (*Mangifera spp*) kernel meal (SMKM) for laying Japanese quails (*coturnix coturnix japonica*)

I n g r e d i e n t s	C o n t r o l (T 1)	T 2 (2 5 %)	T 3 (5 0 %)
M a i z e	5 3 . 2 0	3 9 . 9 0	2 6 . 6 0
SMKM	-	13.30	26.60
Full-fat soybean	26.67	25.85	25.35
Fish meal	5.20	6.00	6.50
Wheat offal	6.93	6.93	6.93
Bone meal	7.00	7.00	7.00
Salt	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5
T o t a l	1 1 0 0 . 0 0	1 0 0 . 0 0	1 0 0 . 0 0

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
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82 M.E (kcal/kg) 2845.01 2900.00 2950.00

83 **Results and discussion**

84 The results of serum biochemical composition are presented in Table 2. The result showed
 85 that serum sodium (Na^+) of quails was within normal range across the treatments [9]. This
 86 report was in contrast with that of [10] who observed hyponatremia in quails fed fermented
 87 taro cocoyam across treatments. This could be attributed to the variations in treatments and
 88 processing methods applied. Serum potassium (K^+) of quails fed 0% and 50% inclusion
 89 levels of SMKM was within normal range [9]. However, the serum potassium of quails fed
 90 25% inclusion levels of SMKM was slightly above the upper limit. This report was not in
 91 agreement with that of [10] who observed that serum potassium values for quails fed 0% and
 92 25% inclusion levels of FTCM was slightly above the upper limit. Serum potassium gives a
 93 true picture of the heart condition, it controls the heart beat rate and blood pressure[11]. The
 94 result for serum chloride was in contrast with that of [10] who reported that, serum chloride
 95 (Cl) of quails fed fermented taro cocoyam was within normal range across the treatments. It
 96 means that quails were not associated with the case of hyperchloremia which is sometimes
 97 associated with excessive fluid loss due to diarrhoea. Hyperchloremia can be symptomatic
 98 with signs of weakness and intense thirst (12).

99 Serum bicarbonate (HCO_3^-) was within normal range (9). This result was similar to that of
 100 [10] who observed that serum bicarbonate of quails fed fermented taro cocoyam meal was
 101 within normal range across the treatments. Implying that acid- base ratio was balanced.
 102 Serum bicarbonate of less than $22\mu\text{mol/L}$ is compatible with metabolic acidosis [13].
 103 However, the deviations observed in the serum electrolyte did not follow a regular pattern
 104 thereby suggesting that SMKM did not influence these results.

105 The liver function test showed that Alanine aminotransferase (ALT) values were within the
 106 normal reference range by [14] across the treatments. It implies that SMKM had no adverse
 107 effect on the liver as higher values of ALT signifies liver damage. This result was similar to
 108 the report of [15] and [10] who reported similar normal range values from broilers fed graded
 109 levels of bitter kola and quails fed fermented taro cocoyam respectively. Aspartate
 110 aminotransferase (AST) of quails fed SMKM were not within normal range. This study
 111 showed that AST was below the lower limit when compared with the normal reference range
 112 established by [9]. Similar low values were recorded by [15] (42.2 – 60.6) for broilers fed

113 graded levels of bitter kola. Low AST value could be as a result of age effect as AST value
 114 depends on age of the bird [16]. Results revealed that uric acid value was lower than the
 115 lower limit of the normal range as observed by [9] for all treatments. Low levels of uric
 116 acid could be attributed to fluctuations in tropical temperatures which have effects on blood
 117 parameters and production [17]. [15] recorded similar low levels (9.63 – 11.08) when graded
 118 levels of bitter kola was fed to broilers. Total bilirubin value was lower than the lower limit
 119 of the normal reference range as observed by [9] for all treatments. High values of bilirubin
 120 indicates liver diseases such as hepatitis, blockage of the bile duct or diagnose conditions that
 121 causes increased destruction of red blood cells [14] as well as protein inadequacy [6].
 122 Bilirubin is produced in the liver, when old red blood cells are broken down. This low value
 123 across treatments shows that the treatments did not affect the result of this parameter, it's
 124 simply because there were no enough old red blood cells to be broken down by the liver as at
 125 the time of blood collection. It therefore implies that SMKM must be a rich source of iron
 126 (Fe^{2+}) and folic acid which help in the building up of blood. Creatinine was within the normal
 127 reference range by [9]. This was in contrast with [14] who observed that broilers fed bitter
 128 kola had creatinine levels below normal range across treatments but was in agreement with
 129 the report of [10] who fed quails with fermented taro cocoyam meals.

130 **TABLE 2:** Serum biochemical composition of laying quails fed varying levels of sun-dried
 131 mango (*mangifera spp*) kernel meal (SMKM)

Sample ID	A S T	A L T	Creatinine	Total bilirubin	Uric acid	N A ⁺	K ⁺	C L ⁻	HCO ₃ ⁻
	U/l	U/l	Mg/dl	Mg/dl	Mg/dl	Mmol/l	Mmol/l	Mmol/l	Mmol/l
0	%	1 9 2 6 3 . 1 4 . 7 6 . 6 1 5 1 3 . 9 1 1 0 2 7							
2 5	%	3 0 1 7 2 . 7 2 . 5 4 . 8 1 4 2 5 . 4 1 2 6 3 0							
5 0	%	3 7 2 2 2 . 4 3 . 6 5 . 2 1 4 8 4 . 7 1 0 6 2 8							

132

Conclusion

This study revealed that, SMKM did not influence the results of the serum electrolytes and AST as the deviations were not peculiar to the test diets, control diet was inclusive. Most importantly, one of the determinant of liver function test; ALT has proven that the liver is normal and healthy across the treatments. SMKM can therefore replace maize in laying quails diets without compromising their health status.

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