



## EFFECT OF SUBSTITUTING FULL-FAT SOYABEAN MEAL WITH TAMARIND (*Tamarindus indica* L.) SEED MEAL ON THE CARCASS CHARACTERISTICS, HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF BROILER CHICKENS

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### ABSTRACT

The effect of substituting full-fat soyabean meal at different levels with boiled Tamarind (*Tamarindus indica* L.) seed meal were evaluated using one hundred and sixty (160) mixed sex Anak 2000 broiler chicks in a study which lasted for eight weeks. The birds were allotted into four treatment groups in a completely randomized design; each treatment consists of forty birds with ten birds per replicate. Boiled tamarind seed meal was used to replace full-fat soybean meal at 0, 5, 10 and 15% levels respectively in diets designated as T<sub>1</sub> (control), T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>. The results revealed high significant (P<0.05) difference at 5% replacement level in Live weight, Slaughter weight, Dressed weight and Dressing percentage. While the Head, Thigh, Breast muscle, Drum stick, Full gizzard and Caeca indicated high significant (P<0.05) difference at different levels of inclusion among the treatment group, but the carcass component revealed higher significant (P<0.05) difference at 5% replacement of boiled Tamarind seed meal for Soyabean which signified that the 5% inclusion of the boiled Tamarind was adequate to the broiler chickens. The result of the blood parameters follows the same pattern with carcass characteristics. The packed cell volume (PCV), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), Lymphocytes and Neutrophils indicated significant (P<0.05) difference at different levels of replacement. Some serum biochemical indices results revealed significantly (P<0.05) higher values at 5% inclusion level. In conclusion, 5% boiled tamarind seed meal significantly (P<0.05) indicated higher performance of the chicken in the carcass characteristic and blood components but can tolerate up to 15% replacement of full-fat Soyabean meal with boiled tamarind seed meal without any adverse effect on the carcass characteristics and blood components of the broiler chickens.

**KEYWORDS:** Broiler Chicken, Soyabean, Tamarind, Carcass, Blood and Parameters.

### INTRODUCTION

The problem of protein malnutrition is real in most countries of the world. Those countries are mostly located in the humid tropics where the level of animal protein intake represent one-tenth of the level of intake in advanced countries (Esonu *et al.*, 2001). The search for alternative feedstuff in the poultry industry has been a major concern to many nutritionists especially in developing country like Nigeria. This search was warranted by the escalating cost and competition by man for conventional poultry feedstuff. The human nutritional value of tamarind (*Tamarindus indica* L.) seed is quite low. It is used widely as animal feed, because ruminants are able to digest its complex starch (Allen and Allen, 1981). The seed contained small amount of anti-nutritional factors such as tannin, phytic acid, hydrogen cyanide, trypsin inhibitors activities and phyto-haemagglutination activities. Therefore, the seed or the testa has to be processed by boiling or roasting to explore the potentials (El-Siddig *et al.*, 2006). Tamarind seeds are rich source of different components and the mineral concentration are high (Ajayi *et al.*, 2006). It contains 24% crude protein, 20% crude fibre, 10.91% fat, 1520.00 Kcal/kg metabolizable energy, 61.70 % carbohydrate and ash

4.20% (Ishola *et al.*, 1990; Siddharaju *et al.*, 1995; Lockett *et al.*, 2000 and Ajayi *et al.*, 2006). With all the beneficial properties of tamarind seed, reports on its value for poultry are limited. Hence, this study was designed to assess the effect of boiled tamarind seed meal on the carcass characteristic, haematological and serum biochemical indices of broiler chickens.

### MATERIALS & METHODS

#### Experimental Stock and Management

One hundred and sixty (160) day-old mixed sex Anak 2000 broilers were obtained from a reputable commercial hatchery. The birds were brooded for seven days. At one week of age, the chicks were randomly assigned to four treatments of 40 birds with 10 birds per replicate in a completely randomized design. Each group was given one of the experimental diets and clean drinking water *ad libitum* throughout the 8 weeks experimental period. The birds were vaccinated against the common poultry diseases in the area. Gomboru vaccine at 2 and 5 weeks of age and Newcastle vaccine (Lasota) at 3 weeks of age.

#### Experimental Diets

The tamarind seeds were sourced from local markets within the Maiduguri Metropolis. They were cleaned and

then boiled in clean water at 100 °C for 30 minutes. It was sun dried for 72 hours, milled and incorporated into the experimental diets. Four experimental diets (starter and

finisher diets) were formulated (Tables 1 and 2). The tamarind seed meal was incorporated at 0% (control), 5%, 10% and 15% levels in the four diets respectively.

**TABLE 1:** Composition of the Experimental Starter Diets

Ingredient	Level of Replacement (%)			
	T <sub>1</sub> (control)	T <sub>2</sub> (5%)	T <sub>3</sub> (10%)	T <sub>4</sub> (15%)
Maize	34.62	34.62	34.62	34.62
Full-fat soyabean	52.23	45.23	40.23	35.23
Tamarind seed	0.00	5.00	10.0	15.0
Wheat Offal	8.65	8.65	8.65	8.65
Bone meal	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00
Salt (NaCl)	0.35	0.35	0.35	0.35
Premix*	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Total	100	100	100	100
Calculated Analysis				
Crude Protein (%)	24.32	22.81	22.23	21.53
Crude Fibre %	4.41	4.20	4.10	4.02
Crude fat %	11.22	10.50	10.20	9.80
Phosphorus	0.47	8.70	16.9	25.1
Calcium	0.15	1.96	2.60	2.80
Methionine	0.40	0.34	0.32	0.30
Lysine	1.41	1.26	1.17	1.10
ME (Kcal/kg)	3019	2864	2775	2686

\* Vitamin premix starter supplied/kg: Vit.A=12000.00 IU, Vit.E=1500 mg, Folic Acid=1000 mg, Panthothenic Acid=15000 mg, Vit.B12=15000 mg, Vit.B6=2500 mg, Vit.K=2000 mg, Choline = 500,000 mg, Mn = 100 mg, Vit.B2=6000 mg, Vit.B1=2000 mg, Biotin =60000 mg, Vit. C = 30000 mg, Copper = 15000 mg, Cobalt = 250 mg , Selenium=100 mg.

**TABLE 2:** Composition of the Experimental Broiler Finisher Diets

Ingredient	Level of Replacement (%)			
	T <sub>1</sub> (control)	T <sub>2</sub> (5%)	T <sub>3</sub> (10%)	T <sub>4</sub> (15%)
Maize	47.61	47.61	47.61	47.61
Full-Fat Soybean	37.14	32.14	27.14	22.14
Tamarind seed	0.00	5.00	10.00	15.00
Wheat bran	11.90	11.90	11.90	11.90
Bone meal	1.50	1.50	1.50	1.50
Limestone	1.00	1.00	1.00	1.00
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Salt (NaCl)	0.30	0.30	0.30	0.30
Premix*	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated Analysis				
Crude Protein (%)	20.21	19.5	18.8	18.1
Crude Fibre %	4.34	4.15	4.14	4.00
Crude fat %	9.20	8.90	8.50	8.10
Phosphorus	0.47	8.7	16.9	25.14
Calcium	0.12	1.98	2.00	2.50
Methionine	0.32	0.30	0.28	0.26
Lysine	1.10	1.00	0.92	0.82
ME (Kcal/kg)	3009	2920	2831	2742

\* Vitamin premix finisher supplied/kg: Vit.A=5000 IU, Vit. D3 = 888,000 IU, Vit.E=12000 mg, Vit.K3 = 1500 mg, Vit.B1=1000 mg, Vit.B2=2000 mg, Vit.B6 = 1500 mg, Niacin = 12000 mg, Panthothenic Acid=2000 mg, Biotin = 10000 mg, Vit.B12=3000 mg, Folic Acid=15000 mg, Choline = 60000 mg, Mn = 10000 mg, Iron = 15000 mg, Zinc = 800 mg, Copper = 400 mg, Iodine = 80 mg, Cobalt = 40 mg, Selenium = 8000 mg.

## Data Collection

### Carcass characteristics

At the end of the experiment, one bird was randomly selected from each replicate, starved overnight (6pm – 6am), weighed the next morning using a digital weighing balance and slaughtered for carcass studies. The dressed weight (carcass) and the weight of the cut-up parts and organs were expressed as percentages of the live weight.

### Blood collection and analysis

During the last week (week 8) of the experiment, blood samples were collected from four birds in each group (i.e. 1 bird per replicate) for determination of haematological and serum biochemical indices. The birds were fasted overnight and blood samples were collected early the next morning via the wing-vein by means of a sterile disposable (21-gauge) syringe and needle, and then placed into sets of sample bottles. One set contained dipotassium salts of ethylene diamine tetra-acetic acid (EDTA K<sup>2+</sup>) and the samples were used for haematological study. The others were plain bottles and the sample were used for the determination of the serum biochemical indices. Packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) counts, and white blood cell (WBC) counts were analyzed according to the methods outlined by Bush (1975). Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated by the formula of Schalm *et al.* (1985). The serum biochemical indices measured were the level of albumin, cholesterol, chlorine, creatinine, glucose, potassium, sodium, total bilirubin, total protein and urea were analyzed according to the methods outlined by Bush (1975) and WHO (1980). Proximate composition of the

experimental diet was carried out according to the methods of AOAC (1980).

### Statistical Analysis

All data collected were subjected to analysis of variance using Statistix (2003) and where means differed, they were separated using the least significant difference (LSD).

## RESULTS & DISCUSSION

The crude protein (CP) for all the diets (Tables 1 and 2) was within the values (22 – 24%) for starters and (19 – 20%) for finishers reported by Olomu (1995). The values for metabolizable energy (ME) were also within the recommended values 2800 ME Kcal/kg and 3000 ME Kcal/kg by Olomu (1995). The crude fibre (CF), ether extract (EE), calcium and phosphorus levels in the diet are higher than the values reported by NIS (1989) and Namra *et al.* (2011). This could be attributed to the decrease in the non-lipid component of the tamarind seeds during boiling. The ash value of 3.00 – 3.40% are lower than 5% recommended by NIS (1989), Onu *et al.* (2001) and Zeitler (2007) which may be as a result of processing method of the tamarind seeds. Similarly, Peter *et al.* (1997) reported that the proportion of meat in valuable parts of the carcass is usually influenced by the diet. The result of carcass and organs measurement is presented in Table 3. The live weight means of 1137.40 – 1865.50 g/bird indicated significant (P<0.05) difference in the group on 5% boiled tamarind seed meal. These values were inferior to the 2495 g/bird reported by Olomu (1995) for broilers; the differences could be due to high ambient temperature (43-44 °C) during the study period which was reported to reduce feed intake and weight gain (Payne, 1990).

**TABLE 3:** Carcass Characteristics of Broiler Chicken Fed Different Levels of Tamarind Seed Meal as a Replacement for Full-Fat Soybean Meal

Parameters	Levels of Replacement (%)				SEM
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	
Live weight g/bird	1633.60 <sup>b</sup>	1865.50 <sup>a</sup>	1166.70 <sup>ab</sup>	1137.40 <sup>ab</sup>	20.473*
Slaughter Weight g/bird	1578.30 <sup>ab</sup>	1626.20 <sup>a</sup>	1201.00 <sup>b</sup>	1101.00 <sup>c</sup>	15.117*
Dressed weight g/bird	1096.30 <sup>b</sup>	1139.30 <sup>a</sup>	705.40 <sup>c</sup>	691.20 <sup>c</sup>	15.117*
Dressing percentage (%)	69.23 <sup>ab</sup>	74.44 <sup>a</sup>	61.23 <sup>b</sup>	62.41 <sup>b</sup>	0.137*
Cut-up parts as percentage of live weight					
Head	3.93 <sup>ab</sup>	3.53 <sup>b</sup>	4.73 <sup>a</sup>	4.86 <sup>a</sup>	0.330*
Thorax	7.94	8.16	10.95	9.94	1.497
Shank	7.14	6.43	8.31	7.70	0.671
Thigh	19.16 <sup>b</sup>	19.33 <sup>a</sup>	16.33 <sup>b</sup>	15.51 <sup>bc</sup>	0.713*
Wing	11.76	11.70	12.93	12.43	0.426
Back	13.56	12.96	12.83	14.23	0.585
Neck	6.56	7.34	6.90	6.46	1.616
Breast	24.60 <sup>c</sup>	27.73 <sup>a</sup>	26.43 <sup>b</sup>	24.82 <sup>c</sup>	0.616*
Drum Stick	14.41 <sup>b</sup>	17.96 <sup>a</sup>	13.86 <sup>b</sup>	14.64 <sup>bc</sup>	0.707*
Abdominal fat	1.76 <sup>b</sup>	3.03 <sup>a</sup>	1.73 <sup>b</sup>	1.92 <sup>b</sup>	0.758*
Weight of organs and other visceral components					
Full Gizzard	3.00 <sup>b</sup>	4.10 <sup>a</sup>	4.33 <sup>a</sup>	3.75 <sup>ab</sup>	0.301*
Empty Gizzard	2.53	2.96	2.90	2.40	0.302
Liver	3.20	3.61	3.73	3.83	0.458
Caeca	0.46 <sup>b</sup>	0.56 <sup>ab</sup>	0.93 <sup>a</sup>	0.96 <sup>a</sup>	0.012*
Heart	1.27	1.03	0.83	1.03	0.168

a, b, c = means within the same rows bearing different superscripts differ significantly (P < 0.05)

\* = significant (P < 0.05), SEM = standard error of the mean

The slaughtered weight and dressed weight were significantly ( $P < 0.05$ ) better at 5% and 10% replacement level of full-fat soybean compared to the (control) fed 0% boiled tamarind seed meal. However, the values recorded here are lower than 70-77% reported by Ravindran and Savakanessam (1996) for broilers. The difference could be attributed to the strain of the birds' temperature of the study environment ( $40 - 42^{\circ} \text{C}$ ), feeding habits of the birds and age as reported by Adele *et al.* (1992) that these factors affect the slaughter weight and dressed weight of broilers. The values of the carcass cut-up parts in this study are superior to the range of values of head 2.36-2.38% and drumstick 9.31-10.25% reported by Dangmo *et al.* (2000) and Oluyemi and Roberts (2000) and the range of 18.87-21.28% for the thigh reported by Onu *et al.* (2001) is slightly lower than the values indicated in this study. While the range of 26.32-27.13% breast muscle reported by Zeitler (2007) is similar to the values (24.60 – 27.73%) obtained in this study. The weight of full gizzard indicated significant ( $P < 0.05$ ) difference at 5% and 10% replacement levels. The gizzard weight (3.00-4.33%) in this study was within the (3.77-4.37%) reported by Oladunjoye and Balogun (2010). The caeca showed high significant ( $P < 0.05$ ) difference, the values (0.46-0.96%) obtained was similar to (0.52-0.63%) reported by Adeniyi and Balogun (2001). The report given by NAPRI (1994) that significant difference exists among treatment when

cotton seed cake was included up to 20% as replacement for soyabean meal in broiler diet, and this study also revealed that feeding boiled tamarind seed meal at 10 and 15% levels of replacement favours gizzard and caeca development because the diets did not contain much fiber which may over work the gizzard and caeca as reported by Oladunjoye and Balogun (2010). This study also indicated that carcass characteristics revealed the effect of processing method reported by Price *et al.* (1979) that moist heat or dry heat treatment eliminate anti-nutritive factors in feed stuff though the anti-nutritive factors was not analyzed in this study. The results for haematological parameters (Table 4) revealed significantly ( $P < 0.05$ ) higher values among the treatment means in PCV, WBC, MCV, MCHC, eosinophils, lymphocytes and neutrophils in the groups on 5% and 10% boiled tamarind seed meal. It has been observed by Esonu *et al.* (2001) and Roberts *et al.* (1990) that haematological constituent reflect the responsiveness of the animals to its internal and external environment which include fed and feeding, levels of antibodies production and bone marrow development. The values obtained in this study were within the normal ranges reported by Swenson (1970); Roberts *et al.* (1990); Anon. (1980); Sturkie (1965) and Frensdon (1981), which is an indication that the birds did not suffer from any allergic conditions, anaphylactic shock, parasitism and anaemia.

**TABLE 4:** Haematological Values of Broiler Chicken Fed Different Levels of Tamarind Seed Meal as a Replacement for Full-Fat Soybean Meal

Parameters	Levels of Replacement (%)				SEM
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	
Packed Cell Volume (PCV) (%)	33.33 <sup>c</sup>	35.66 <sup>a</sup>	33.00 <sup>c</sup>	35.00 <sup>b</sup>	0.108*
Haemoglobin concentration (Hb) (g/dl)	11.37	12.33	12.20	12.20	0.906
White blood cell (WBC) ( $\times 10^3 / \text{mm}^3$ )	5.30 <sup>b</sup>	7.30 <sup>ab</sup>	8.85 <sup>a</sup>	8.60 <sup>a</sup>	0.818*
Red blood cell (RBC) ( $\times 10^6 / \text{mm}^3$ )	2.52	2.52	2.61	2.46	0.148
Mean corpuscular volume (MCV) (fl)	132.6 <sup>b</sup>	141.7 <sup>a</sup>	126.5 <sup>c</sup>	141.9 <sup>a</sup>	0.24*
Mean corpuscular Hb (MCH) (Pg)	45.03	49.03	46.99	49.41	3.70
Mean Corpuscular Hb conc.(MCHC) (%)	31.20 <sup>b</sup>	34.64 <sup>ab</sup>	37.11 <sup>a</sup>	35.8 <sup>ab</sup>	2.39*
Eosinophills (%)	6.00 <sup>a</sup>	1.50 <sup>b</sup>	3.00 <sup>b</sup>	2.50 <sup>b</sup>	0.577*
Lymphocytes (%)	34.0 <sup>b</sup>	30.0 <sup>a</sup>	41.0 <sup>b</sup>	38.0 <sup>b</sup>	2.199*
Neutrophills (%)	44.00 <sup>c</sup>	63.50 <sup>a</sup>	56.00 <sup>b</sup>	59.50 <sup>ab</sup>	1.915*

a, b, c, d = means within the same rows bearing different superscripts differ significantly ( $P < 0.05$ )

\* = significant ( $P < 0.05$ ), SEM = standard error of the mean

**TABLE 5:** Serum Biochemical Indices of Broiler Chicken Fed Different Levels of Tamarind Seed meal as a Replacement for Full-Fat Soybean Meal

Parameters	Levels of Replacement of Tamarind Seed (%)				SEM $\pm$
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	
Total Protein (g/dl)	26.10 <sup>b</sup>	27.93 <sup>a</sup>	25.90 <sup>ab</sup>	25.70 <sup>ab</sup>	0.446*
Albumin (g/dl)	1.90	2.03	1.73	2.03	0.245
Cholesterol (mmol/L)	2.40 <sup>c</sup>	4.93 <sup>a</sup>	3.06 <sup>b</sup>	2.36 <sup>c</sup>	0.327*
Chlorine (mmol/L)	91.67	91.67	91.67	92.00	1.528
Creatinine (mmol/L)	5.86	3.86	4.73	5.93	2.703
Glucose (mmol/L)	6.67 <sup>a</sup>	5.00 <sup>b</sup>	5.67 <sup>b</sup>	7.33 <sup>a</sup>	4.796*
Potassium ( $\text{K}^+$ ) (mmol)	2.66	2.76	3.36	3.56	0.435
Sodium ( $\text{Na}^+$ ) (mmol)	123.30 <sup>d</sup>	135.30 <sup>a</sup>	127.70 <sup>c</sup>	130.30 <sup>b</sup>	3.064*
Total bilirubin (mmol/L)	0.40	0.30	0.23	0.46	0.139
Urea (mg/dl)	1.20	1.50	1.86	1.90	0.338

a, b, c, d = means within the same rows bearing different superscripts differ significantly ( $P < 0.05$ )

\* = significant ( $P < 0.05$ ), SEM = standard error of the mean

Table 5 showed the results of serum biochemical indices. Feeding boiled tamarind seed meal revealed significant ( $P<0.05$ ) difference among the treatments mean in cholesterol, glucose, sodium and total protein at the (control), 5%, and 15% replacement levels compared to other group. No significant ( $P>0.05$ ) difference were observed in albumin, chlorine, creatinine, potassium, total bilirubin and urea. It was well documented that serum biochemical indices has direct correlation to the quality of the diet and feeding (Merck, 2011; Kwari *et al.*, 2011). The cholesterol values significantly ( $P<0.05$ ) indicated higher range than the range of 1.35-3.83 mmol/L reported by Mitruka and Rawnsley (1977) which is an indication of heart disease, but no clinical signs was observed during the study. This may also be attributed to nutritional pattern, level of anti-nutritional factors in the boiled tamarind seed meal and types of feed (Aderemi, 2004 and Summer and Spratt, 2000). The glucose value is within the range of 6.93 to 11.09 mmol/L for chickens reported by Mitruka and Rawnsley (1977). The sodium and potassium values ranged (123-135.30 mmol/L and 2.66-3.56 mmol/L) are also within values of (1135.40 mmol/L) reported by Uchegbu *et al.*, (2010) but is higher than (114 - 120 mmol/L and 4.10 - 4.97 mmol/L) reported by Iheukwumere, (2007). Sodium and potassium are known to regulate osmotic pressure, maintain membrane potentials and acid base balance and transmit nerves impulse and its deficiency affect the tubes of kidney resulting in an inability to concentrate urine. It also causes alteration of gastric secretions and internal mobility (Follis *et al.*, 2012, Strenten and Williams, 2009). The total protein is higher than the 24.00 g/l for broilers reported by Uchegbu *et al.* (2010). Total serum protein has been reported as an indication of the retained protein in animal body (Akinola and Adeola, 1991 and Esonu *et al.*, 2001). In conclusion, boiled tamarind seed meal does not have any adverse effect on carcass characteristics and blood components of broiler chickens, and replacement of full-fat soyabean meal up to 15% in this study revealed better carcass characteristics and blood components at 5% and 10% replacement levels.

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