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airjournals@gmail.com; enquiry@airjournal.org

A Study of Broiler Birds Fed Fresh Hura Crepitans Based Diets: Growth and Blood Impact

Ininiuma, O. Timothy

Department of Biology, Faculty of Science

University of Port Harcourt, Rivers State, Nigeria

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ABSTRACT

Growth response and haematological indices of broiler birds of 28 weeks of age fed raw Hura crepitans seed meal (HSM) as a partial replacement for maize and soybean was examined. Three hundred (300) broiler birds were assigned to five dietary treatments (T1, T2, T3, T4 and T5) in a completely randomized design of 60 birds per treatment, replicated thrice with each replicate having 20 birds. The control diet had 0% Hura crepitans meal while T2, T3, T4 and T5 had 5%, 10%, 15% and 20% HSM. The raw seed meal was moderate in protein (24.80%) and crude fibre(11.82%) but very high in ether extract (39.45%). The seed was also moderate in trypsin inhibitor (0.92mg/g), Tannin (0.51mg/g), Cyanide (0.23mg/g) and saponin(0.33mg/g). The HSM produced statistically significant ($p<0.05$) depression in feed intake, final live weight, average weight gain, feed conversion ratio and protein efficacy from inclusion level above10% HSM, and tended to be depressed ($P<0.05$) more as the inclusion levels of Hura crepitans meal increased in the diets with the least values recorded for birds on treatment diet 5(20%) Hura crepitans meal. The abdominal fat deposit inceased significantly ($P<0.05$) as the level of Hura crepitans meal increased in the diets. The nutrient retension showed a significant ($P<0.05$) effect only on fibre, ether extract and protein retention among other nutrient retention parameters. Both the fibre and protein retention were significantly depressed only at 15% and 20% TSM. The organs showed no significant differences except for the liver that shrinks at the 15% and 20% inclusion levels of HSM. The haematological indices also showed significant differences, with a notable reduction in Red Blood Cells (RBC), packed cell volume (PCV) and haemoglobin (Hb) but only at the 20% HSM inclusion level. It was concluded that not more than 10% of fresh Hura crepitans could replace parts of maize and soybean meal in broiler diets without any adverse effect on growth performance and only at 20% will the haematological parameters of broiler birds be affected.

Keywords: *Hura crepitans, growth response, haematological indices, Broiler, Birds, feeds*

1. Introduction

In developing countries, conventional energy and protein feedstuffs are not only scarce but are expensive. The utilization of unconventional feed resources that are less in demand by man and his industries, in a way has reduced feed cost (Oladunjoye *et al.,* 2003; Nsa *et al.,* 2010).

This ultimately lowers the cost of livestock since the cost of feed accounts for 70-80% of the total cost of poultry production (Nsa *et al.,* 2008). Therefore, has led to the search for alternative feedstuffs, that as a matter of necessity must be easily available, easy to procure, easy to be produced and processed and must have a comparable cost advantage over the conventional feedstuff (Oyebiyi *et al.,* 2007).

A species that can be exploited in this direction is *Hura crepitans* (sandbox). It possesses as much agronomic and nutritional potential as the conventionally used energy and protein sources. The seed dry matter is between 91-95% an indication of its good long storage life which will make it devoid of moldy growth. The seed is moderate in crude protein (23-28%) but high in amino acids levels especially lysine, methionine, cysteine, threonine and histidine (Shonekam and Ayayi, 2016)). The seed is said to be high in oil (38.95-51.24%), making it a good energy source for livestock feed. However, the seed is noted to contain some anti-nutritional factors like trypsin-inhibitor, tannin when consumed caused vomiting, diarrhea and cramps (Nnaji, 2010; Oyeleke et al., 2012; Gbadamosi and Osungbade, 2017).

This research therefore evaluates the growth response and haematological constituents of broiler birds to diets containing different levels of raw *Hura crepitans* (sand box) seed meal as a partial replacement for maize and soybeans.

Materials and Methods

Source and Processing of *Hura crepitans* seed

The matured sand box seeds were plucked from trees within Calabar Municipality where the experiment was also conducted. The seeds were separated from its casing (dehulled) and sundried for 6 days and finally oven dried at 120^{o}C for 6 hours. The seeds were further milled with a meadow model 35 hammer mills and sieve through a mesh of 5mm after passing it through ethanol as a defeating agent. The proximate composition of the test ingredients and diets were determined by the method of AOAC (1990) while phytate and tannin by method of Mega (2002), Alkaloids, saponin and haemagglutinins by method of Liener, (1995).

Table 1.1 Proximate composition and anti-nutritional factors of raw Hura crepitans meal

Proximate Components (%)	
Dry matter	92.40
Crude Protein	24.80
Crude fibre	9.48
Ether extract	28.04
Ash	4.81
Nitrogen Free Extract	32.87
Anti-nutritional factor (mg/g)	
Trypsin Inhibitor	0.92
Tannin	0.51
Cyanide	0.23
Saponin	0.33
Haemagglutinin (Hu/g)	188.05

Diets and management of birds

Five experimental diets were formulated in such a way that Diets T_1 contained 0% HSM which served as the control diet. The proportion of maize and soybean were partially replaced by 5%, 10%, 15% and 20% HSM to from Diets T_2, T_3, T_4 and T_5 respectively. The diets were made to be iso-caloric and iso-nitrogenous. Three hundred (300) day old broiler chicks of 'Hacco' strain of mixed sex were raised on a common diet (vital feed) for 28 days with all needed vaccination and medication giving before being randomly divided equally into 5 groups of 60 birds each. Each groups

had 3 replicates of 20 birds each. Feed and water were given *ad libitum* for the period of 28 days of which the experiment lasted.

At the end of the experiment 3 birds per replicate were randomly selected and separated into metabolic cages for nutrient retention experiment, after 4 days of acclimatization, feacal droppings collected and feed were taken for analysis.

Table 1.2 Gross composition of experimental diets

Ingredients (%)	Levels of inclusion of Hura crepitans meal (HCM)				
	0%	5%	10%	15%	20%
Maize	56.50	51.50	46.50	41.50	36.50
HCM	0.00	5.00	10.00	15.00	20.00
SBM	27.00	29.00	31.00	33.00	35.00
Wheat Offal	10.00	8.00	6.00	4.00	2.00
Fish Meal	2.25	2.25	2,25	2.25	2.25
Bone meal	3.50	3.50	3.50	3.50	3.50
***Vit/Min Premix**	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis %					
Crude protein	22.01	21.97	21.94	21.90	21.88
Crude fibre	4.50	4.52	4.58	4.61	4.69
Available phosphorus	0.81	0.79	0.78	0.77	0.75
Calcium	1.21	1.20	1.18	1.18	1.16
ME(Kcal/kg)	3005.18	3011.10	3019.21	3024.50	3035.50
Determined Analysis %					
Crude protein	21.58	21.47	21.34	21.22	21.11
Crude fibre	4.16	4.29	4.35	4.52	4.70
Gross energy(mg/kg)	4.09	4.11	4.13	4.16	3.19
Ether extract	3.58	3.62	3.66	3.71	3.90
Ash	7.81	7.62	7.50	7.41	7.37

* Vitamin/mineral premix containing the following per kg. Vitamin A, 8,000,000 IU; vitamin D3, 1,600000 IU; Vitamin E, 5,000 IU; Vitamin K, 2,000 mg; Thiamine, 1,500 mg; Riboflavin B2, 4,000 mg; Pyridoxine B6, 1,500 mg; Antioxidant, 125 g; Niacin, 1,500 mg; Vitamin B12, 10 mg; Pantothenic acids, 5,000 mg; Folic acid, 500 mg; Biotin, 20 mg; Choline chloride 200 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 12 g' Selenium, 200 mg; Cobalt, 200 mg.

Carcass and Haematological indices

At the end of the experiment, three birds per replicate were randomly selected starved overnight and slaughtered by severing the jugular vein, the blood was put in labeled sterile universal bottles containing ethyl diamine tetra acetic acid (EDTA) powder as anti-coagulant. The same birds were eviscerated for internal organs measurement. The percentage of packed cell volume (PCV) was determined by centrifugation of capillary tubes for 5minutes at 1200rpm, the haemoglobin content (HB) was determined by the methods of Jain (1986). The Red Blood Cells (RBC) was determined using the Hendricks fluid in an improved neubaur ruling counter chamber.

Statistical Analysis

Data collected were subjected to analysis of Variance. Differences between the treatment means were separated using Duncan's Multiple Range Test (Duncan, 1985). All statistical procedures were according to the methods of Steel and Torrie (1980).

Results and Discussion

The proximate composition and anti-nutritional factors of the test ingredient (table 1) fall within the range of values reported by Esonu *et al.* (2014) for Hura crepitans meal. The raw seed meal is moderate in protein (24.80%) and crude fiber (11.82%) and very high in ether extract (39.45%). The protein and ether extract values were within the range of 23-28% crude protein and 38.95-51.24% of either extract reported by Esonu *et al.* (2014), Olumide *et al*. (2017). The seed was also moderate in trypsin inhibitor (0.92mg/g), Tannin (0.51mg/g), Cyanide (0.23mg/g) and saponin(0.33mg/g) when compared to other and seeds like mucuna bean, soyabeans as reported by Ukachukwu and Obioha (1997).

There were significant ($p<0.05$) declines in the final live weight (FLW) and Average weight gain (AWG) as the level of Hura crepitans meal increased in the diets above 10%. The observed depression may be attributed to the tannin and phytates content of raw *Hura crepitans* meal which increased with increasing dietary levels. The presence of these anti- nutritional factors in feeds has been shown to reduce growth rate of broilers due to reduced protein absorption and specific amino acids utilization (Douglas *et al.,* 1992; Elkin *et al.,* 2007; Olaposi *et al*., 2017; Olumide, 2017)). However, the depression effect of these parameters from 10% inclusion levels of Raw *Hura crepitans* meal in broiler diets contradict the level of inclusion of Hura crepitans meal in broiler diet where depression was only noticed from 15% inclusion levels as the report of Esonu *et al.* (2014). These differences could be due to differences in nutrient content of the diet as well as feedstuffs composition of researchers' diets.

The feed consumption was equally significantly ($p<0.05$) influenced by inclusion level of raw *Hura crepitans* meal and also for birds on T_4 (15%) and T_5 (20%) who showed significant ($p<0.05$) depression.

Hura crepitans meal is fibrous compared to soybean and maize, it is replacing, high level of it means highly fibre level, this according to savory and gentle should have increased intake to allow birds meet their dietary components other than energy but the reverse was the case. The contradiction could be attributed to the high energy density of the feed. raw *Hura crepitans* meal has high oil content (39.4%), increasing level of raw Hura crepitans meal in the feed means increase in energy density of feed, and birds are known to eat to meet its energy needs and once satisfied, intake is hampered (Nsa *et al.,* 2009).

Tannins are known to lower feed intake and reduced growth rate if their threshold levels are exceeded in a diet (Jansman, 1993). High level of raw *Hura crepitans* meal ranslates to high level of tannin. It is therefore likely that 15% and 20% inclusion of raw *Hura crepitans* meal has shut up the tannin above the threshold level of 0.5% as reported by Jansman, (1993).

The reduced feed intake may equally lead to reduce weight gain.

Raw *Hura crepitans* meal inclusion similarly significantly ($P<0.05$) declined feed conversion ratio and protein efficiency at 15% and 20% *Hura crepitans* meal

Significant ($p<0.05$) depression in feed utilization and protein efficiency as the level of HSM increases in the diets agrees with Birk and Peri (1980) who noted that phytates is capable of forming complexes with cations resulting in reduced availability of calcium, magnesium, potassium and copper and that with reduced availability of these nutrients and minerals, animals consuming diets with some probable level of phytates may not be able meet their nutrient requirements for tissue accretion hence the feed utilization is impaired (Fanimo *et al.,* 2007).

Hura crepitans meal has reasonable level of phytates and fibre and when included in a high level will surely depress feed and protein utilization. The results of poor feed utilization are also in line with Ortiz *et al.,* 1994, who reported containing extract on feed gain ratio. Also, high level of fibre according to Onyeikegbulem (2011) decreased the utilization of crude protein and other nutrients.

Results of nutrient digestibility showed a significant ($p<0.05$) decrease in crude protein, crude fibre and ether extract from 15% inclusion level of HSM. The observed low fibre and protein utilization from 15% raw *Hura crepitans* meal attributes to the high fibre contact of the feed at that level, according to Hedge *et al.,* 1998; Trait and Writ, 1990), fibre decreases the availability of nutrient by reducing the period of exposure of the food to the digestive enzymes and absorptive surfaces and this according to them is due to increased rate of passage induced by fibre which in turn affects the absorption of nutrients.

Also, high level of oil in the feed limits the utilization of minerals and vitamins which could help in nutrient absorption (Nsa *et al.,* 2008).

Phytic acid lowers the bioavailability of minerals and inhibits enzymatic digestion of ingested proteins. (Nolan and Duffin, 1987). This could also be responsible for the poor nutrient retention when inclusion levels of raw Hura crepitans meal exceed 10% in the broiler diets.

Among the internal organs measured, only the liver showed significant differences. Percentage weight of liver was significantly ($p<0.05$) depressed as the level of raw *Hura crepitans* meal exceed 10%. This confirms the claim that liver may be the primary target organ of anti-nutritional factors present in the raw seed meal. This result is in line with findings by (Salgakar and Sohomie, 1965; Ikegwonu and Bassir, 1975; Ukachukwu, 2008) who observed birds fed with meal with anti-nutritional factors to have shrink liver, they all concluded that the primary target organ for anti-nutritional factor is the liver.

The abdominal fat deposit increases significantly as the level of raw *Hura crepitans* meal increased in the diet. This observation corresponds with the report of Nsa *et al*. (2008), who earlier reported that high fibre and high oil feed encourage abdominal fat deposit in broiler birds. HSM is of high fibre and oil when compared to the maize and soybean it is replacing in the diets.

Treatment diets 5 (20%HSM) showed significant ($p<0.05$) reduction of red blood cells (RBC) and packed cell volume (PVC) and hemoglobin (Hb) The haematological reduction suggests that trypsin inhibitor could be implicated. The raw sand box had earlier been found to have trypsin inhibitor (Gbadamosi and Osungbade, 2017) activity Ohoghobo *et al.* (1993) reported localization of trypsin inhibitor in a base soluble fraction of lima bean. They led the base soluble protein fraction to broilers and observed consistent reduction of RBC and HB in the birds. They concluded that this suggest, the direct involvement of trypsin inhibitor. However, the values of all the measured haematological indices were within limits for avian species (Fraser and May, 1986).

Table 1.3 Performance characteristic and haematological indices of broiler birds fed diets containing raw *Hura crepitans* meal

Parameters	Inclusion level of raw Hura crepitans					
	0%	5%	10%	15%	20%	SEM
Initial Weight	810.50	812.00	816.10	809.45	809.55	11.89
Final live Weight	2980.16^{a}	3100.09^{a}	2980.00^{a}	2816.50^{b}	2440.00^{c}	9.99
Weight gain(g/bird/day)	41.66^{a}	42.00^{a}	40.91^{a}	34.68^{b}	27.14^{c}	2.65
Feed intake(g/bird/day)	126.43^{a}	128.94^{a}	126.61^{a}	114.90^{b}	101.00^{b}	7.22
Feed gain (g of feed/g of Wt gain)	3.03^{c}	3.02^{c}	3.09^{c}	3.40^{b}	3.72^{a}	0.65
Protein intake(g)	26.73^{a}	27.19^{a}	26.66^{a}	24.17^{b}	21.26^{c}	1.18
Mortality (%)	0.00	0.20	0.03	0.00	0.10	0.00
Cost of 1kg feed consumed(N)	97.75^{a}	97.00^{b}	96.25^{c}	95.50^{d}	94.69^{e}	10.16
Cost of 1kg feed consumed/Weight gain(N/g)	296.65^{c}	297.79^{c}	297.88^{c}	316.41^{b}	352.73^{a}	22.17
Feed cost savings (%)	-	-0.38	-0.41	-6.66	-18.90	0.00
Haematological indices						
Packed cell volume (%)	39.10^{a}	38.92^{a}	38.91^{a}	37.05^{a}	33.66^{b}	5.88
Hemoglobin(g/dl)	13.00^{a}	13.05^{a}	12.92^{a}	12.71^{a}	10.11^{b}	1.43
Red blood cell(g/dl)	4.33	4.28a	4.29a	4.07	3.41b	0.83
White blood cell(x103dl)	6.01	6.22	6.18	6.29	6.10	0.59
Platelet(g/dl)	175.40	178.00	171.66	172.00	169.44	22.67

Table 1.4 Organs weights and nutrient retention of broiler birds fed raw *Hura crepitans meal*

Relative weights of organs (%)						
Dressing percentage	79.10	78.72	76.16	76.10	74.60	10.10
Kidney	0.79	0.78	0.76	0.74	0.71	0.06
Spleen	0.22	0.23	0.25	0.27	0.27	0.01
Liver	2.10^{a}	2.07^{a}	2.05a	1.85^{b}	1.76^{b}	0.32
Pancreas	0.33	0.31	0.31	0.31	0.30	0.04
Heart	0.59	0.60	0.62	0.62	0.65	0,02
Lungs	0.71	0.72	0.71	0.74	0.74	0.06
Abdominal fat	0.34^{e}	0.61^{d}	0.78^{c}	0.98^{b}	1.11^{a}	0,11
Nutrient retention (%)						
Dry matter	81.65	81.49	81.32	81.20	81.01	11.20
Crude protein	78.41^{a}	76.44^{a}	76.02^{a}	72.92^{b}	72.51^{b}	2.22
Crude fibre	37.46^{a}	37.66^{a}	37.81^{a}	34.30^{b}	30.05^{c}	1.90
Ether extract	71.65^{a}	71.90^{a}	72.17^{a}	71.40^{a}	65.72^{b}	2.73
Nitrogen free extract	80.11	80.20	80.23	80.44	80.72	3.18

Conclusion

The result of this study revealed that HSM should not be included above 10% in broiler diets at can impaired performance. However, it is believed that with a good processing method to knock out the activity factors, a higher level might be tolerated and improvement in the growth performance parameters could be achieved in broiler birds' production.

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