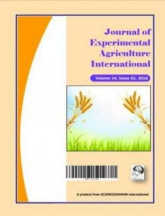

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Effects of Heat Treated Jatropha Seed Cake-Based Diets on Performance and Blood Metabolites in Broiler Chickens

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The study was carried out to investigate the effect of heat treated Jatropha Seed Cake (JSC) on the performance, serum biochemistry and haematology of broiler broiler chicken over the period of 28 days feeding trial between March and April, 2015.

Two hundred one-week-old Arbor Acre broilers were randomly allotted to 4 dietary treatments with 5 replicates having 10 chickens in each group. Chicks were fed diets containing JSC at 0 (control), 5, 10 and 15% dietary levels represented as treatments 1, 2, 3 and 4, respectively in a completely randomized design.

Performance indices were assessed. On day 28, blood sample was collected from the jugular vein of two birds per replicate for haematological and serum biochemical analyses. Data were analyzed using descriptive statistics and ANOVA at α0.05.

Results showed that highest weight gain (WG) (872.1g/b) was recorded for birds on the control diet while the least WG (553.98g/b) was for birds on 15% JSC diet. Meanwhile, birds on 5 and 10% JSC had similar final weight and WG. Identical feed intake was observed in birds on 5, 10 and 15% JSC diets which was significantly (*P* =.05) lower than what was recorded for birds on the control diet. Feed conversion ratio of birds on the control diet, 5 and 10% JSC-based diets were (*P* =.05) improved as compared to those on 15% JSC diet. There was no mortality recorded for birds on the

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dietary treatments. There were no significant differences observed in the blood metabolites of birds on the experimental diets.
In conclusion, body weight gain and feed intake of birds on heat treated jatropha seed cake decreased as the level of JSC increases across the diets, but this did not elicit any deleterious effect on the birds. Jatropha seed cake can therefore be considered as a potential feed resource in broiler nutrition.

Keywords: Jatropha seed cake; heat treatment; growth response; blood parameters; broilers.

1. INTRODUCTION

One of the main obstacles to the growth of livestock industry in most developing countries is high cost of feed which often account for 60-80 percent of the total cost of production [1]. A pragmatic approach that has been explored by animal scientists to solve this problem is the use of cheap and readily available but less utilized waste products of agro-industries to replace the conventional feedstuffs in order to reduce feed formulation cost. Jatropha plant is one of such. *Jatropha curcas* is a multipurpose drought resistant shrub belonging to the family Euphorbiaceae. It is extensively cultivated in Central and South America, Africa, and Southeast Asia [2]. The oil from jatropha is mainly converted into biodiesel but after extraction of the oil, the residue such as seed cake or kernel is regarded as a waste and improper disposal of this by-product can constitute potential environmental damage. Jatropha seed cake (JSC) contains 48-60% crude protein, higher essential amino acids excluding lysine and substantial amount of energy and minerals [3]. However, it contains anti-nutrients such as tannin, saponin, lectin and a toxic principle: phorbol ester which hinders its utilization in livestock feeding [4]. Jatropha seed cake can be used in broiler diet as replacement for soyabean meal if properly detoxified. Many processing methods have been explored to detoxify JSC but with inherent limitations. The objective of this study, therefore, was to determine the effect of heat treated jatropha seed cake on the performance and blood profile of broiler chickens.

2. MATERIALS AND METHODS

2.1 Experimental Site

The research work was conducted at the Poultry unit of the Teaching and Research farm, University of Ibadan, Oyo state, Nigeria. The University is located at latitude 7^{o} 10^{o} N and longitude 3^{o} 2^{o} E and lies in the South-western part of Nigeria with a prevailing tropical climate with a mean rainfall of about 1037mm per annum.

2.2 Management of Birds and Experimental Diets

Two hundred (200) one-day-old Arbor Acre broilers were brooded for one week which after they were allotted to 4 dietary treatments consisting of 5 replicates of 10 birds each in a completely randomized design. The jatropha seeds were sourced from a reliable jatropha plantation in Ibadan, Oyo state, Nigeria. The processing method was done to simulate the technique carried out by local farmers as described by Agboola and Adenuga [5]. The experimental diets (Table 1) were given *ad libitum* and they had free access to clean water. Four diets were formulated with varying inclusion levels of jatropha seed cake (JSC) to substitute for soyabean meal (SBM) to meet the nutrient requirements of broiler chickens [6]. Treatment 1 was the basal (corn-soyabean meal diet) with no JSC. Treatments 2, 3 and 4 contained the basal diet and 5, 10 15% JSC at the expense of SBM respectively.

2.3 Performance Indices

Weekly feed intake was calculated as difference between amounts given and left over. The birds were weighed on weekly basis and values were used to calculate body weight gain and feed conversion ratio.

2.4 Haematological Parameters

On day 28, blood was collected from the jugular vein of two birds per replicate into two vaccutainer tubes for each poult, one containing Ethylene Diamine Tetracetic Acid (EDTA) for haematological study and the other sterile vaccutainer tubes without EDTA for serum biochemical analyses. Red Blood Cell and White

Table 1. Gross composition (g/100g DM) of experimental diets

Ingredient	0	5	10	15
Corn	51.50	51.50	51.50	51.50
Soyabean meal	42.50	40.37	32.85	36.12
Jatropha seed cake	0.00	2.13	4.25	6.38
Soyabean oil	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.60	1.60	1.60	1.60
Limestone (38% Calcium)	1.40	1.40	1.40	1.40
Salt	0.25	0.25	0.25	0.25
*Vit-Min Premix	0.25	0.25	0.25	0.25
DL- Methionine	0.35	0.35	0.35	0.35
L-Lysine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Crude protein	23.0	23.1	23.2	23.3
Metabolizable energy (Kcal/kg)	3084	3097	3109	3121
Calcium	0.94	0.94	0.93	0.93
Total phosphorus	0.70	0.69	0.68	0.66
Non-phytate phosphorus	0.44	0.43	0.43	0.42
Lysine	1.59	1.58	1.58	1.58
Methionine	0.63	0.65	0.68	0.71

*Vit-Min= Vitamin-Mineral, *Composition of Premix per Kg of diet: vitamin A, 12,500 I.U; vitamin D_3, 2,500 I.U; vitamin E, 40mg; vitamin K_3, 2mg; vitamin B_1, 3mg; vitamin B_2, 5.5mg; niacin, 55mg; calcium pantothenate, 11.5mg; vitamin B_6, 5mg; vitamin B_{12}, 0.025mg; choline chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg; selenium, 0.12mg; Anti-oxidant, 120mg.*

Blood Cell (WBC) were determined using Neubauer haemocytometer after the appropriate dilution. Packed cell volume (PCV) was determined as described by Wintrobe [7] using Wintrobe haemotcrite method. WBC differential leukocyte counts were performed using the oil – immersion objective examination of blood films stained with the modified Romanovsky's Giemsa stain [8]. Platelets were determined by phase microscopy method of [9].

2.5 Serum Metabolites

The biuret method was utilized in the determination of the total protein fraction while the serum albumin was subjected to the direct colorimetric method for albumin with Bromocresol Green (BCG) as the dye as described by Peters et al. [10]. Serum creatinine was determined using the principle of Jaffe reaction as described by Bonsnes and Tausslay [11], while serum urea was determined by the kit (Quinica Clinica Spam), the Uricase method as described by Wootton [12].

2.6 Chemical and Statistical Analyses

The proximate composition of the diets was determined by the methods of [13]. Data obtained were analyzed using ANOVA of [14] and significant level of $P = .05$ was used. The treatment means were compared using Duncan Multiple Range Test.

3. RESULTS AND DISCUSSION

Chemical composition of jatropha seed cake is presented in Table 2. The crude protein level was 47.97% while the crude fibre, ether extract, ash, nitrogen free extract and metabolizable energy were 6.98%, 2.66%, 5.87%, 36.52% and 3193.Kcal/kg respectively. Chivandi et al. [3] recorded higher crude protein and ash contents for industrially processed Zimbabwean *Jatropha curcas.*

Table 2. Chemical composition (g/100g DM) of jatropha seed cake

Variable	%
Dry matter	95.07
Crude protein	47.97
Crude fibre	6.98
Ether extract	2.66
Ash	5.87
Nitrogen free extract	36.52
Metabolizable energy (Kcal/kg)	3193.0

The result of performance characteristics of broilers fed varying levels of heat treated

Jatropha seed cake (JSC) is shown in Table 3. There were significant differences (*P* = .05) observed in the final weight (FW), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) of birds on the experimental diets. Highest final weight (1002g/b) and weight gain (872.1g/b) were recorded for birds on the control diet while the least FW (685.38g/b) and WG (553.98g/b) were for birds on 15% JSC diet respectively. Meanwhile, birds on 5 and 10% JSC had similar FW and WG. The results of the final weight and weight gain of birds on experimental diets showed that inclusion of Jatropha seed cake (JSC) in the diet of broilers did not improve the body weight gain of the birds at various inclusion levels when compared to birds on the control diet. This result is in agreement with the experiment conducted by Pasaribu et al. [15] who fed broiler chicks with jatropha seed meal (JSM) diets that were processed using different methods of detoxification. This also corroborates the findings of [5] who reported significant weight loss in growing Japanese quails fed 15-20% inclusion levels of JSC.

The feed intake of birds decreases as the levels of jatropha seed cake increased across the dietary treatments. However, identical feed intake was observed in birds on JSC-based diets which was significantly (*P* = .05) lower than what was recorded for birds on the control diet. This observation was similar to the findings of [15]. The authors reported significant decrease in the feed intake of birds fed both physically and chemically treated JSM as compared to the birds on the control diet. The authors concluded that JSM had a negative effect on palatability and general acceptability even at 4% inclusion level. This supports earlier observations by Chivandi et al. [3] and Belewu et al. [16]. However, this was in contrast to the findings of [17] who reported a positive response of common carps to detoxified jatropha kernel meal in terms of acceptability and palatability which compared favorably with those fed the control diet.

Feed conversion ratio (FCR) of birds on the control diet, 5 and 10% JSC-based diets were (*P* = .05) improved as compared to those on 15% JSC diet. This was in disagreement with the findings of [18] who postulated that inclusion of JSM had no remarkable effect on FCR in albino rats. This was further posited by Pasaribu et al. [15] who reported no significant effect of jatropha seed meal on feed conversion ratio in broiler chickens. There was no mortality recorded for birds on the experimental diets in this study. This was contrary to the reports of [5] who reported higher percentage mortality recorded in growing Japanese quails fed 10-15% JSC – based diets. This could probably be attributed to the bigger body size and well-developed gastrointestinal tract of broilers in effectively metabolizing the anti-nutrients in jatropha seed cake-based diets compared to Japanese quails [5].

The result of serum biochemical indices and hematological parameters of broiler chickens on Jatropha seed cake diets is presented in Table 4. The haematological parameters are important indices that portray the physiological state of the individual animal and its significance, in interpreting the blood profile in healthy and diseased conditions is one of the primary objectives of haematological studies [19]. Adeyemi et al. [20] averred that serum biochemical constituents are positively correlated with the quality of the diets. All the haematological indices and serum biochemical parameters of broiler chickens on the experimental diets measured were similar in all the treatments and are within the normal ranges reported for broilers [21]. This could probably be inferred that the heat treatment employed in detoxifying the phorbol ester, which has been identified as the main toxic anti-nutrient in

Table 3. Performance characteristics of birds on experimental diets Jatropha seed cake inclusion (%)

Parameter	0	5	10	15	SEM
Initial weight (g/b)	129.90	129.30	129.96	131.40	2.54
Final weight (g/b)	1002.00^{a}	856.02^{b}	799.72^{b}	685.38^{c}	30.78
Weight gain (g/b)	872.10^{a}	726.72^{b}	669.76^{b}	553.98^{c}	31.16
Feed intake (g/b)	1419.18^{a}	1242.40^{b}	1158.24^{b}	1118.94^{b}	38.33
Feed conversion ratio	1.63^{b}	1.70^{b}	1.70^{b}	1.96^{a}	0.07
Mortality (%)	0	0	0	0	

^{a,b,c} *Means with different superscripts in same row are significantly different (P<0.05)*

Table 4. Blood indices of broiler chickens on varying levels of jatropha seed cake diets
Jatropha seed cake inclusion (%)

Parameter	0	5	10	15	SEM
Creatinine (mg/100ml)	0.49	0.34	0.33	0.54	0.07
Total protein (g/dL)	3.42	3.58	3.56	3.44	0.15
Albumin (g/dL)	1.73	1.90	1.79	1.78	0.08
Globulin (g/dL)	1.69	1.67	1.76	1.66	0.14
ALB/GLO	1.07	1.18	1.03	1.09	0.12
Urea (mg/100ml)	4.87	4.45	5.02	5.58	0.35
Packed cell volume (%)	31.80	33.70	32.20	33.06	1.80
Red blood cell ($x10^{12/L}$)	3.43	3.40	3.39	3.55	0.07
White blood cell ($x10^{9/L}$)	17.98	16.95	17.11	16.78	0.43
Lymphocyte (%)	63.80	65.00	64.90	57.40	2.37
Heterophils (%)	27.40	29.40	29.70	35.40	2.97
Monocyte (%)	3.60	3.20	2.96	3.70	0.33
Eosinophils (%)	4.80	4.10	4.20	3.70	0.71
Basophils (%)	0.40	0.30	0.20	0.30	0.13
Platelets ($x10^{9}/^{L}$)	141.50	139.90	127.70	126.70	46.26

Means with the same superscripts on each row are similar significantly, ALB - Albumin, GLO - Globulin

jatropha seeds, was effective as the blood metabolites of birds on JSC diets were identical with those on the control diet. This supports the findings of [18]. The results of the haematological parameters obtained in this study were similar to the reports of [22] when Japanese quails were fed detoxified jatropha seed cake. The results of the present study indicate that the diets contain adequate nutrients to support the health of birds without compromising the functions of blood parameters.

4. CONCLUSION

In conclusion, body weight gain and feed intake of birds on heat treated jatropha seed cake decreased as the level of JSC increases across the diets. The blood metabolites indicated that jatropha seed cake-based diets did not elicit any deleterious effect on the birds. It can therefore be considered as a potential feed resource in broiler nutrition. However, for improved growth performance of broiler chickens, further processing of jatropha seed cake is recommended.

DISCLAIMER

This manuscript was presented in the conference.
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COMPETING INTERESTS

Author has declared that no competing interests exist.

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