



EFFECTS OF FEEDING COOKED TALLOW (*Detarium microcarpum*) SEED MEAL SUPPLEMENTED WITH ENZYME TO BROILER CHICKENS

¹Sabo, A., ¹Abdullahi, M. A., ¹Sulaiman, R., ¹Jaafar, A. M. and ²Ahmed, A. M.

¹Department of Animal Science, Sa'adu Zungur University, Bauchi - Nigeria.

²Department of Crop Science, University of Maiduguri, Borno - Nigeria

Corresponding Author's Email: anassabo012@gmail.com, GSM: 08038900154

ABSTRACT

A feeding trial was conducted to investigate the effect of feeding cooked tallow (*Detarium microcarpum*) seed meal supplemented with enzyme on growth performance, serum biochemistry and carcass parameters of broiler chickens. During the feeding trial, three hundred (300) day-old Cob-500 broiler chicks were randomly allotted to five different experimental diets with three replicates each containing twenty birds in a Completely Randomized Design (CRD). The inclusion levels were 0% for the control diet and 10% CDMSM each for diet 2, 3, 4 and 5 cooked for 30, 60, 90 and 120 minutes respectively and the enzyme (maxigrain[®]) was added at 10g/100kg feed. The result revealed a significant ($P<0.05$) difference across dietary treatments for final weight gain, daily weight gain, daily feed intake and feed conversion ratio and this indicated that supplementation of enzyme to broiler finisher diets had effect on the performance parameters. The result of serum biochemical parameters indicated a significant ($P<0.05$) difference among the treatment in AST, ALT and creatinine but no significant ($P>0.05$) differences across the treatment means for total protein, albumin, cholesterol, triglycerides and glucose levels of the broiler chickens. The result of live and organ weights obtained in the second experiment showed that, there were significant ($P<0.05$) differences across the treatment means for live weight, dressed weight and dressing percentage of the birds but gizzard, abdominal fat and spleen were not significantly ($P>0.05$) influenced. The result of live and organ weights obtained in the second experiment showed that there were significant ($P<0.05$) differences across the treatment means for live weight, dressed weight and dressing percentage of the birds but gizzard, abdominal fat and spleen were not significantly ($P>0.05$) influenced by the treatment. In conclusion, addition of enzyme (maxigrain[®]) on cooked Tallow (*Detarium microcarpum*) seed reduced the anti-nutritional factors but did not improve the performance of birds when compared to the control diet and further research needs to be carried out to explore the best cooking durations of *Detarium microcarpum* seeds and determine the appropriate enzyme to be used.

Keywords: *Detarium microcarpum*, Performance, Serum biochemical and Carcass parameters.

INTRODUCTION

Poultry encompasses domesticated avian species including *Gallus gallus domesticus*, *Anas platyrhynchos domestica*, *Meleagris gallopavo*, and *Anser anser*, which are cultivated primarily for the production of meat and eggs intended for human consumption (Mozdziak, 2019; Bello *et al.*, 2022). A notable increase in the consumption of poultry meat has been observed, particularly within the regions of East and Southeast Asia as well as Latin America, with specific emphasis on the nations of China and Brazil. Presently, Nigeria is recognized for possessing the second largest population of chickens in the African continent, boasting a standing stock of approximately 180 million birds which yield over 14 billion eggs and 454,000 tonnes of meat on an annual basis (Masaki *et al.*, 2020). Feed enzymes represent the most extensively researched category of feed additives. The utilization of enzymes in poultry



nutrition has a storied history, with the inaugural documentation of an enzyme product, referred to as protozyme, emerging in the 1920s (Aehle, 2004). Carvalho *et al.* (2009) and Bertechini *et al.* (2009) reported optimal digestibility outcomes with the use of protease, thereby corroborating the efficacy of the protease enzyme in enhancing the digestibility of protein derived from feed ingredients. These scholars employed methods such as NFE diet or basal diet substitution to ascertain the digestibility of amino acids within various ingredients, establishing the suitability of protease for incorporation into poultry feeds. Proteases engage in multifarious biological functions. These enzymes are integral to crucial physiological phenomena including homeostasis, apoptosis, signal transduction, reproduction, and immune response (Headstrom, 2002). Consequently, the integration of protease enzymes has been proposed to mitigate the digestibility impairments resulting from enzyme inhibition. Nonetheless, over the past three decades, advancements in the understanding of the chemistry of target substrates within feed ingredients have facilitated the precise tailoring of enzyme production to cater to specific substrates. Furthermore, significant progress has been made in the realm of biotechnology, particularly in the domains of fermentation, microbiological technologies, and molecular biology (Pierson *et al.*, 2004). Despite a broader acceptance of enzyme supplementation, the responses elicited remain inconsistent, and numerous inquiries persist regarding the methodologies for leveraging enzymes to attain reliable outcomes. The variability in these responses not only highlights existing limitations but also underscores the potential opportunities for amplifying the advantages of enzyme responses, which are inherently linked to three fundamental components: the enzyme, the substrate, and the avian species (Cowieson *et al.*, 2006). This study, therefore, aims to assess the impacts of incorporating cooked tallow (*Detarium microcarpum*) seed meal supplemented with enzymes on the growth performance, serum biochemistry, and carcass characteristics of broiler chickens. This endeavor is anticipated to significantly contribute to reducing production costs and enhancing the profitability of farmers. The outcomes of this investigation will also provide a foundational basis for subsequent research and serve as a reference for policymakers.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the poultry unit of the Department of Animal Science Teaching and Research Farm, Sa'adu Zungur University, Bauchi.

Source of Experimental Material and Animals

The *Detarium microcarpum* seeds were sourced from Darazo market in Darazo Local Government Area of Bauchi State, Nigeria and 300-day-old chicks were sourced from a reputable hatchery. The proteolytic enzyme (maxigrain) was purchased from a livestock market.

Processing of *Detarium microcarpum* seeds

The *Detarium microcarpum* seeds were subjected to four (4) different cooking regimes. The fruits were cracked open to collect the seeds. The seeds were then cleaned of dirt and put in a bowl of water to boil at 100°C under open drums using fire wood. The seeds were cooked for 30min, 60min, 90min and 120min and the timing begun when the water started boiling. The cooked seeds were partially dehulled to remove the seed coats, washed, sun-dried and milled to obtain *Detarium microcarpum* seed meal (DMSM).

Experimental Design and Managements of Birds

Three hundred (300) day-old broiler chicks were randomly allotted to 5 experimental treatments with 3 replicates of 20 birds each in a Completely Randomized Design (CRD). All



routine management practices and necessary biosecurity measures were carried out. Feed and water were provided *ad-libitum* throughout the period of the experiment.

Experimental Diet

Five (5) iso-nitrogenous and iso-caloric experimental diets were formulated for the experiment with diet 1 serving as the control diet (0% DMSM and enzyme) while diet 2, 3, 4, and 5 contained enzyme and 10% each of DMSM cooked for 30min, 60min, 90min and 120min respectively. The diets were fed from 5-8 weeks. Table 1 shows the composition of experimental diets. The experimental diets were formulated to meet the nutrient requirements standard for broiler chickens as described by NRC, (1994).

Table 1: Composition of Broiler finisher diet containing cooked *Detarium microcarpum* seed meal supplemented with enzyme

Ingredient (%)	Cooking durations of DMS (minutes)				
	0	30	60	90	120
Maize	65.00	57.00	57.00	57.00	57.00
SBM	15.70	16.00	14.00	13.00	12.00
DMSM	0.00	10.00	10.00	10.00	10.00
Groundnut Cake	15.30	13.00	15.00	16.00	17.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/Min. Premix**	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Analysis					
Metabolizable Energy (kcal/kg)	3000	3014	3019	3023	3029
Crude Protein (%)	20.08	20.07	20.21	20.37	20.46
Crude Fibre (%)	3.76	3.43	3.59	3.75	3.82
Ether Extract (%)	0.55	0.74	0.63	0.72	0.73
Calcium (%)	1.13	1.13	1.13	1.13	1.13
Available P. (%)	0.56	0.55	0.55	0.55	0.55
Methionine (%)	0.55	0.53	0.52	0.52	0.52
Lysine (%)	1.10	1.05	1.02	1.01	1.00
Feed cost (₦/kg)	103.30	94.94	94.24	93.89	93.54

**Vitamin-Mineral Premix will provide per Kg the following: Vitamin A, 10,000IU; Vitamin D₃, 2,200,000IU; Vitamin E, 10,000mg; Vitamin K₃, 2,000mg; Vitamin B₁, 1,500mg; Vitamin B₂ 5000mg; Vitamin B₆, 1,500mg; Vitamin B₁₂, 10mg; Folic acid, 500mg; Niacin, 15,00mg; Calpan, 5000mg; Biotin, 20mg; Antioxidant, 125,000mg; Cobalt, 200mg; Selenium, 200mg; iodine, 1,000mg; Iron, 40,000mg; manganese, 70,000mg; Copper, 4,000mg; Zinc, 50,000mg; choline chloride 150,000mg, DMSM = *Detarium microcarpum* seed meal, SBM= Soya bean meal, DMS = *Detarium microcarpum* seed.

Data Collection

Performance Parameters:

Performance parameters such as initial body weight, final body weight, weight gained, feed intake, feed conversion ratio and feed cost/kg gain measured and calculated. Feed intake and body weight gain were taken weekly and were used to calculate average daily feed intake and average daily weight gained. Mortality was recorded as it occurs during the experiment.



Serum Biochemical Study:

At the end of the finisher phase, three (3) birds were randomly selected from each treatment and 2.0mls of blood was collected through the wing vein with the aid of a sterilized needle into sterile bottles for determination of biochemical indices such as total protein, albumin, globulin, urea, cholesterol and triglyceride. Samples were taken to the Clinical Pathology Laboratory, Abubakar Tafawa Balewa University Teaching Hospital for the analysis using the standard clinical chemistry procedure (Olorede and Akinloye, 2002).

Carcass Analysis

At the end of the finisher phase, three (3) birds were selected from each replicate based on the average weight of the group and used for carcass evaluation. The birds were fasted overnight, bled by severing the jugular vein, de-feathered using hot water and eviscerated. The carcass prime cuts were weighed and expressed as percentage of carcass weight while the organs weights were expressed as percentage of live weight.

Ethical Clearance

Ethical approval on animal handling, use and care was obtained from Committee on Animal Use and Care, Sa'adu Zungur University, Bauchi before the commencement of the experiment.

Data Analysis

All data collected were subjected to analysis of variance (ANOVA) using the general linear model procedure of Statistical Analysis System (SAS, 2021). Significant differences between treatment means were determined using Duncan's Multiple Range Test (Duncan, 1955).

Experimental Model

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

Y_{ij} = Observations for dependent variables

μ = Overall mean

T_i = fixed effect of treatment (different cooking regimes)

E_{ij} = random residual effect

RESULT AND DISCUSSION

Growth Performance

Table 2 shows the performance of broiler finisher chickens fed diets containing cooked *Detarium microcarpum* seed meal supplemented with enzyme. The result revealed a significant ($P < 0.05$) difference across dietary treatments for final weight gain, daily weight gain, daily feed intake and feed conversion ratio. The daily weight gain of broiler chickens fed control diet and birds fed diets containing CDMSM cooked for 30, 90 and 120 minutes were statistically similar and higher compared to the birds fed diet containing CDMSM cooked for 60 minutes. This similarity may be as a result of improved utilization of feed by the broiler finisher chickens due to enzyme supplementation and it was also reported by Bawa *et al.* (2012) that enzyme supplementation enhanced the efficiency of feed utilization. This result agreed with the report of Esuga *et al.* (2008) who also observed a significant difference in body weight gain of broiler chickens fed diets containing palm kernel meal with enzyme supplementation. The highest daily feed intake was recorded in birds fed diet containing CDMSM cooked for 120 minutes while the least was obtained in birds fed control diet. The daily feed intake for all the treatments were statistically similar which indicated an increased in feed intake of broiler finisher chickens fed diets containing CDMSM supplemented with enzyme. This also is in conformity with the report of Esuga *et al.* (2008). Feed conversion ratio was better in birds fed control diet while the poorest was recorded in birds fed diet containing CDMSM cooked for 60 minutes. The

poorest FCR observed in birds fed diet containing CDMSM cooked for 60 minutes showed poor utilization of feed by the chickens in this group while birds fed the control diet and birds fed diets containing CDMSM cooked for 30, 90 and 120 minutes were statistically similar in FCR. This similarity in FCR may be as a result of enzyme supplementation to the diets containing CDMSM which improved utilization in broiler finisher chickens. The result is similar to the report of Daramola *et al.* (2020). The difference in feed cost/kg gain recorded in birds fed the control diet compared to the poorest value in birds fed diet containing CDMSM cooked for 60 minutes may be attributed to the poor utilization of feed by the birds. This means that supplementation of enzyme had not significantly affected the feed cost/kg gain of birds fed diet containing CDMSM cooked for 60 minutes. The highest (4.00%) mortality was observed in birds fed diet containing CDMSM cooked for 60 minutes as compared to other dietary treatments but did not show any significant difference.

Table 2: Growth performance of Broiler finisher chickens (5-8) fed diets containing cooked *Detarium microcarpum* seed meal supplemented with enzyme.

Parameters	Cooking duration of DMS (minutes)					SEM
	0	30	60	90	120	
Weight at 4weeks (g/bird)	462.50 ^a	370.00 ^b	379.83 ^b	392.50 ^b	392.54 ^b	23.74
Final Weight (g/bird)	1252.55 ^a	1043.47 ^{ab}	943.33 ^b	1036.67 ^b	1083.33 ^{ab}	82.16
Daily Weight Gain (g/bird)	27.73 ^a	23.47 ^{ab}	20.12 ^b	23.00 ^{ab}	24.67 ^{ab}	2.48
Daily Feed Intake(g/bird)	62.38 ^b	66.12 ^{ab}	68.26 ^{ab}	64.83 ^b	71.36 ^a	2.75
Feed Conversion Ratio	2.26 ^a	2.87 ^{bc}	3.43 ^c	2.84 ^{bc}	2.92 ^{bc}	0.37
Feed Cost/(₦/kg gain)	243.65	285.42	338.71	279.46	286.60	-
Mortality (%)	1	1	4	1	2	-

^{abc}= Means on the same row with different superscripts are significantly different (p<0.05), SEM: Standard error of mean, DMS = *Detarium microcarpum* seed.

Serum Biochemical Parameters

The result of serum biochemical parameters of broiler chickens fed diet containing cooked *Detarium microcarpum* seed meal supplemented with enzyme was presented in Table 3. The result indicated that, there were similarities in ALT between birds fed control diet and birds fed diet containing CDMSM cooked for 30, 60 and 120 minutes which are higher compared to the other treatments. There were no significant (P>0.05) differences across the treatment means for total protein, albumin, cholesterol, triglycerides and glucose levels of broiler chickens fed diets containing cooked *Detarium microcarpum* seed meal supplemented with enzyme. The non-significant difference across the treatments means for globulin, total protein, albumin, glucose, total cholesterol, triglyceride, creatinine and alanine amino transferase conformed with the result of Obun *et al.* (2017), who pointed out that there were no significant differences across all the parameters in serum biochemistry. There were significant (p<0.05) differences across dietary treatments means for aspartate amino transferase, alanine amino transferase and creatinine and the discrepancy in Aspartate amino transferase indicated that the liver was significantly affected by the inclusion of CDMSM in the diet of broiler chickens. Iyayi and Tewe (1998) observed that total protein and creatinine contents depended on both the quantity and quality of protein supplied in the diet.

Table 3: Serum biochemical parameters of Broiler chickens fed diets containing Cooked *Detarium microcarpum* seed meal supplemented with Enzyme

Parameters	Cooking duration of DMS (minutes)						Normal range
	0	30	60	90	120	SEM	
Glucose (mg/dl)	8.00	8.75	8.40	8.50	8.90	0.70	199.00-348.00 ⁺
Total Protein (g/dl)	3.85	2.55	3.95	2.60	3.35	0.73	3.60-5.50 ⁺⁺
Albumin (g/dl)	0.60	0.80	0.90	0.80	0.95	0.38	1.10-2.20 ⁺⁺
Creatinine (mg/dl)	30.50 ^b	40.50 ^{ab}	29.00 ^b	43.50 ^{ab}	52.00 ^a	7.91	0.10-0.40 ⁺
Cholesterol (mg/dl)	3.90	4.30	4.85	3.05	3.50	1.31	2.23-5.17 ⁺⁺⁺
ALT (μ L)	5.50 ^a	4.50 ^{ab}	2.50 ^b	6.00 ^a	4.50 ^{ab}	1.09	-
AST (μ L)	59.00 ^b	80.00 ^a	48.50 ^b	62.00 ^b	52.50 ^b	6.30	100.00-400.00 ⁺⁺
Triglycerides (mg/dl)	0.65	0.60	0.70	0.70	0.60	0.15	<135.00 ⁺⁺⁺

^{a, b} = Means on the same row with different superscripts are significantly different ($p < 0.05$) mean, ALT = Alanine amino transferase, AST = Aspartate amino transferase, ⁺Jardine, 2014, ⁺⁺ Ross *et al.* (1976), ⁺⁺⁺Mitruka and Rawnsley, 1997, SEM: Standard error of mean, DMS = *Detarium microcarpum* seed.

Carcass Parameters

Table 4 indicates the carcass parameters of broiler chickens fed diets containing cooked *Detarium microcarpum* seed meal (CDMSM) supplemented with enzymes. The result shows a significant difference ($P < 0.05$) across the treatment means for live weight, dressed weight and dressing percentage of birds. The significant differences observed across the treatments in live weights, dressed weights and dressing percentage of the birds indicated that enzyme supplementation of diets containing CDMSM did not improve feed utilization in birds fed diet containing CDMSM.

The higher live weight and dressing percentage observed in birds fed the control diet compared to birds fed diets containing CDMSM cooked for 30, 60, 90 and 120 minutes confirmed the minimal effect of enzyme supplementation. The spleen was not significantly influenced by the dietary treatments supplemented with enzyme. This conformed to the report of Aguihe *et al.* (2016) who also observed a non-significant difference in spleen when enzyme is supplemented to broiler diets.

The significant differences in all other organs measured such as heart, liver, lungs, kidney, pancreas, intestinal length, intestinal weight and caecal weight showed that enzyme supplementation had negative effect on the organs weight. This result is contrary to the report of Ewa *et al.* (2019).

Table 4: Effect of diets containing cooked *Detarium microcarpum* seed Meal supplemented with enzyme on the carcass parameters of Broiler chickens

Parameters	Cooking duration of DMS (minutes)					SEM
	0	30	60	90	120	
Live weight (g/bird)	1214.33 ^a	951.00 ^c	951.66 ^c	976.66 ^{bc}	1094.00 ^{ab}	56.08
Dressed weight (g/bird)	897.66 ^a	703.33 ^b	711.33 ^b	688.33 ^b	758.33 ^b	37.28
Dressing percentage (%)	73.81 ^a	64.07 ^{ab}	64.47 ^{ab}	60.63 ^b	61.66 ^b	4.79
Major organs (expressed as % of live weight)						
Heart	0.60 ^a	0.54 ^{ab}	0.50 ^b	0.43 ^c	0.55 ^{ab}	0.26
Gizzard	2.13	1.96	1.94	2.15	2.01	0.11
Liver	1.93 ^d	2.75 ^{ab}	2.09 ^{cd}	2.42 ^{bc}	2.96 ^a	0.18
Lungs	0.59 ^a	0.55 ^{ab}	0.50 ^{bc}	0.44 ^c	0.56 ^{ab}	0.29
Kidney	0.57 ^b	0.79 ^a	0.81 ^a	0.61 ^b	0.70 ^{ab}	0.05
Pancreas	0.18 ^b	0.31 ^a	0.35 ^a	0.23 ^b	0.20 ^b	0.02
Abdominal fat	1.50	1.36	1.70	1.70	1.31	0.16
Spleen	0.90	0.11	0.11	0.10	0.10	0.01
Intestinal length (cm)	153.00 ^c	159.33 ^c	168.66 ^b	178.66 ^a	185.33 ^a	3.35
Intestinal weight	2.67 ^c	3.11 ^b	3.35 ^b	3.87 ^a	3.96 ^a	0.16
Caecal weight	0.37 ^c	1.12 ^b	1.40 ^a	1.37 ^a	1.21 ^{ab}	0.09

^{abcd} = Means on the same row with different superscripts are significantly different (p<0.05), SEM: Standard error of mean, DMS: *Detarium microcarpum* seed.

CONCLUSION AND RECOMMENDATION

From the outcome of this experiment, the following conclusions and recommendation were made;

- That addition of enzyme (maxigrain[®]) on cooked Tallow (*Detarium microcarpum*) seed reduced the content of anti-nutritional factors.
- That supplementation of enzyme (maxigrain[®]) to Cooked *Detarium microcarpum* seed meal has not significantly improved the feed utilization and consequently the performance indices.
- It is recommended that further research be conducted to ascertain the exact enzyme and adequate cooking durations or proper processing methods to be used.

ACKNOWLEDGEMENT

We wish to appreciate and acknowledge the effort of the Tertiary Education Trust Fund (TETFund) for funding this research work through Institutional Based Research (IBR) funding.

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