

Production performance of broiler chickens fed UMUCASS 36 cassava foliage meal supplemented with exogenous enzyme



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Abstract

Cassava foliage is a waste in cassava production in Nigeria. The foliage contains moderate percentage of crude protein which can help reduce the cost of soya bean meal used in broiler production. 150 1-day-old Abor acres strain of broiler chicken were used for 49 days to evaluate the performance of broiler chicken fed cassava (UMUCASS 36) foliage meal supplemented with Alphaxynase® MultiGrain enzyme as substitute for soya bean in broiler diets. The harvested cassava foliage was sun dried for five days until crispy to touch. Five diets (T₁ – T₅) were formulated with varying inclusion levels of the cassava foliage meal at 0, 2.5, 5, 7.5 and 10% with enzyme at 0.2g/kg across diets, respectively. The chicks were randomly allocated into five treatments of 30 birds per treatment which were replicated thrice with 10 birds per replicate using Completely Randomized Design. Final body weight of birds fed T₂ was the best (3366.67g) but differed significantly ($P < 0.05$) from the weights of other birds on other diets. Average daily body weight gain, average daily weight gain and feed conversion ratio followed the same trend as observed in final body weight. Birds fed enzyme supplemented diets had a significant reduction in feed intake and positive effect on the performance of birds that consumed it. The carcass characteristics and organ proportion followed the same trend as seen in growth performance. It was concluded that 2.5% inclusion of UMUCASS 36 foliage meal supplemented with Alphaxynase® MultiGrain enzyme can be included in broiler diets without adverse effect on broiler chicken.

Keywords: Alphaxynase® MultiGrain enzyme, broiler chicken, UMUCASS 36 CASSAVA, growth performance

Performance de production des poulets de chair nourris avec de la farine de feuilles de manioc UMUCASS 36 supplémentée avec une enzyme exogène



Résumé

Les feuilles de manioc constituent un déchet dans la production de manioc au Nigeria. Ces feuilles contiennent un pourcentage modéré de protéines brutes qui pourraient aider à réduire le coût de la farine de soja utilisée dans l'élevage de poulets de chair. Cent cinquante poussins de chair de souche Abor Acres âgés d'un jour ont été utilisés pendant 49 jours pour évaluer les performances des poulets nourris avec de la farine de feuilles de manioc (UMUCASS 36) supplémentée avec l'enzyme Alphaxynase® MultiGrain en remplacement partiel de la farine de soja dans leur alimentation. Les feuilles de manioc récoltées ont été séchées au soleil pendant cinq jours jusqu'à obtenir une texture croustillante. Cinq régimes alimentaires (T₁ à T₅) ont été formulés avec des niveaux d'inclusion variables de farine de feuilles de manioc (0 %, 2,5 %, 5 %, 7,5 % et 10 %), tous supplémentés avec 0,2 g/kg d'enzyme. Les poussins ont été répartis aléatoirement en cinq traitements de 30 oiseaux chacun, chaque traitement étant répliqué trois fois avec 10 oiseaux par répétition selon un dispositif complètement randomisé. Le poids corporel final des oiseaux nourris avec le régime T₂ a été le meilleur (3366,67 g), mais différait significativement ($P < 0,05$) de celui des oiseaux sous les autres régimes. Le gain de poids quotidien moyen, la prise de poids moyenne et l'indice de conversion alimentaire ont suivi la même tendance que le poids corporel final. Les oiseaux nourris avec des régimes supplémentés en enzyme ont montré une réduction significative de la consommation alimentaire et un effet positif sur leurs performances. Les caractéristiques de la carcasse et la proportion des organes ont suivi la même tendance que les performances de croissance. Il a été conclu qu'une inclusion

de 2,5 % de farine de feuilles de manioc UMUCASS 36 supplémentée avec l'enzyme Alphaxynase® MultiGrain peut être intégrée dans l'alimentation des poulets de chair sans effet négatif sur leur croissance.

Mots-clés : Enzyme Alphaxynase® MultiGrain, poulet de chair, manioc UMUCASS 36, performance de croissance

Introduction

Poultry, particularly chickens are the most widely and most numerous kept animal species in the world (Moreki *et al.*, 2010). Some of the reasons include their large number (133 – 165 million, Kperegbe *et al.*, 2009), fast growth rate, greater affordability, ease of rearing, absence of taboos to production and consumption and absence of barriers to production in any climatic zone in the country. However, a lot of factors have been identified to be militating against the poultry industry in spite of the increase in poultry production. The main factor hindering the rapid expansion of poultry production in Nigeria is the inadequate supplies of feedstuffs at affordable prices (Adedokun *et al.*, 2020). Feed is the most expensive input in poultry production as it constitutes about 70-80 percent of the variable cost of production in reared stocks. The cost of grains in the feed industry has led to the quest for alternative source of energy feed (Akinmutimi and Ukpabi, 2008). Unfortunately, many of these non-conventional feed resources seemed to be inadequate, or have replaced maize and other grains only at the marginal levels. Non-conventional protein sources include cassava leaf meal and other agro-industrial by products, which are more readily available or cheaper (Adedokun *et al.*, 2020).

However, the leaves have become increasingly important as a source of nutrient for monogastric and ruminant animals (Wanapat, 2000). Cassava leaves are rich in protein but they are low in sulfur amino acids (Adedokun *et al.*, 2018). The leaf protein is reported to be limiting in methionine and tryptophan but rich in lysine (Adedokun *et al.*, 2018). By the addition of multi-enzyme, the biological value could be increased. The role of exogenous enzymes as feed additives in poultry diets is well established. Addition of exogenous multi-enzymes to monogastric animal feed reduced viscosity of ingesta in the intestine and showed a marked improvement on the various morphological effects of feeding fibrous materials to non-ruminant animals (Michael and

JUha, 2021). It was noted that documented information is still scanty on the use of multi-enzyme (Alphaxynase® MultiGrain), on the utilisation of cassava waste. Thus, the thrust of this study was to improve the utilisation of UMUCASS 36 cassava foliage by broiler chickens through enzyme supplementation. The UMUCASS 36 cassava foliage contains fibre which binds the nutrients making them not available to the animals, hence the need for supplementation with multi-enzymes.

Materials and Methods

Experimental Location

The research was conducted at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. Umudike lies on latitude 05°29' N and longitude 07°33' E with an elevation of 122 m above sea level and is located in the tropical rainforest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22°C - 36°C and relative humidity of 50-95 % depending on the season and location (NRCRI, 2019).

Procurement of experimental materials

Cassava foliage meal

The leaves and tender stems of UMUCASS 36 cassava was collected at the point of harvest from cassava farm of National Root Crops Research Institute (NRCRI). They were then chopped into smaller sizes of 3cm long and sun dried for five days before using hammer mill to mill and sieved with sieve of two millimeter screen. The cassava leaves with petioles and the tender stem was mixed at ratio 4:1 four parts of the leaf with petioles and one part of tender stem. This formed the foliage meal which was packaged in air tight polythene bag ready for use.

Source of Enzyme

The enzyme- ALPHAXYNASE® MULTIGRAIN that was used in this study was purchased from the manufacturer (Sunson SBE-03FA). Sunson Industry Group Co, Limited Suit 1307, Zhongan, Shengye building Chaoyang

District, Beijing China (100101). Through ISV chemical venture zone A Road 3 Aladeowo Street, Lada, off Omi Adio Abeokuta Road, Ibadan Oyo State, Nigeria. The product is an innovative thermostable multi-component carbohydrase derived from *Trichoderma reesei*. It contains a complex range of different activities, of which xylanase (endo1,4-β-xylanase; EC 3.2.1.8) and β-glucanases (endo-1,3(4)-β-glucanase; EC 3.2.1.6 and endo-1,4-glucanase: EC 3.2.1.4) are guaranteed activities. But it also contains some amounts of beneficial side activities such as ferulic acid esterases and arabinofuranosidases. Alphaxynase® MultiGrain delivers improved energy utilisation, ensures flexible formulation, improved performance, reduced feed cost and high retention. These enzymes help to improve the release of entrapped nutrients within the tight cell walls of fibrous feed materials.

Source of Feed Stuff

The ingredients used for the preparation of the test diets were purchased from Jocan and Allied Products Ltd, producers of agro raw materials, apex feed located at Igbo street Umuahia, Abia State.

Experimental birds and management

A total of one hundred and fifty 1-day-old Abor acres strain of broiler chicks were purchased from Agrited Farms Ibadan, Oyo State and raised at the Poultry Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. The birds were housed in a deep litter brooding pen at day-old. The chicks were brooded for two weeks and reared to nine weeks of age by conforming to standard management procedures. The birds were fed and watered *ad libitum* with commercial starter diet (crude protein, 23%; metabolizable energy of 3000kcal/g) from day old to one week of age and the mixture of test diets with the commercial starter in the second week before a complete

introduction of the test diet. Proper sanitation and routine medication was maintained to forestall any outbreak of disease.

Experimental procedure

One hundred and fifty chicks were assigned in a Completely Randomized Design to five treatments with three replicates of ten birds per replicate. The formulated straight or single broiler diets were used for the period of seven weeks.

Experimental Design and Statistical Analysis

The experimental design was Completely Randomized Design using five treatments with three replicates of ten birds each. All data collected were subjected to analysis of variance (Steel and Torrie, 1980), and significant differences between treatments means was separated by Duncan’s multiple range test (Duncan, 1955). The model of the design was:

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

Where Y_{ij} = single observation ie j^{th} observation on the i^{th} treatment.

μ = overall mean

T_i = the effect of

the i^{th} level of treatment

e_{ij} = experimental error assume to be independently identically and normally distributed with zero means and constant variances .

Experimental diets

The processed cassava foliage meal supplemented with enzyme was used to formulate five diets, at 0, 2.5, 5, 7.5 and 10% levels designated T_1 , T_2 , T_3 , T_4 and T_5 , respectively to replace soya bean meal. The foliage meal were cassava foliage meal and cassava tender stem at ratio 4:1 proportion. The composition of the experimental diets are shown in Table 1. The proximate composition of the cassava foliage meal was also done using the method of (AOAC 2000)

Table 1: Experimental diets containing varied levels of processed UMUCASS 36 cassava foliage meal supplemented with enzyme fed to broiler chickens

Ingredients (%)	Diets				
	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%)	T5 (10%)
Maize	40.50	40.50	40.50	40.50	40.50
Soyabean meal	35.00	34.12	33.25	32.37	31.50
Cassava foliage meal	-	2.50	5.00	7.50	10.00
ALPHAXYNASE®	+	+	+	+	+

Maize offal	16.80	16.80	16.80	16.80	16.80
Blood meal	1.50	1.50	1.50	1.50	1.50
Palm oil	0.50	0.50	0.50	0.50	0.50
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated nutrient composition					
ME (kcal/g)	2853.89	2833.79	2813.77	2793.67	2773.64
Crude protein	22.29	22.09	21.89	21.68	21.48
Energy : Protein	128 : 1	128 : 1	128 : 1	128 : 1	129 : 1

*To provide the following per Kg. of feed: Vitamin A 10,000iu; Vitamin D3, 2000iu; Vitamin B1 0.75mg; Nicotinic acid, 2.5mg; vitamin E, 2.5mg; cobalt, 0.40mg; Biotin, 0.50mg; Folic acid, 1.00mg; Cholin chloride, 2.5mg; Copper, 8.00mg; Manganes, 64mg; Iron, 32mg; Zinc, 40mg; Iodine, 0.8mg; Flavomycin, 100mg; Spiromycin, 5mg; DL – methionine, 56mg; L.Lysine, 120mg and Selenium, 0.16mg.

Data Collection

Determination of growth parameters

Data were collected for a period of seven weeks.

The following parameters were measured

Initial body weight: this was assessed by weighing the birds at the beginning of the experiment using single pan electronic balance (Scientech Single Pan Electrical Balance in 3 decimal places in grammes) to weigh the chicks.

Final body weight: this was assessed by weighing the birds at the end of the experimental period using triple beam balance (Ohanus in kg).

Feed intake/bird/day (g) = $\frac{\text{Quantity of feed given} - \text{Quantity not eaten}}{\text{No. of birds} \times 49 \text{ days}}$

Daily weight gain/bird (g) = $\frac{\text{Final live weight} - \text{Initial weight}}{\text{No. of birds} \times 49 \text{ days}}$

Feed conversion ratio = $\frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$

% mortality = $\frac{\text{Number died}}{\text{No. of birds}} \times 100$

Stocked

Carcass characteristics and organ proportions

The carcass characteristics and organ proportions was determined by slaughtering three birds per treatment (one per replicate) at the end of the feeding trial. The birds slaughtered were fasted for 24 hours to empty the digestive tract but water was supplied *ad-libitum*. Slaughtering was done by a clean cut across the jugular vein and the birds were allowed to bleed for at least three minutes. The birds were de-feathered by dipping into 70°C water for one and a half minutes and then the feathers were removed. The carcasses were cut into parts and the organs separated according to the procedure described by Ojewola and Longe (1999). All parts (breast, drumstick, thigh, wings and back-cut) were weighed and expressed as percentage dressed weight. Organs like liver, heart, gizzard, kidneys were also weighed and expressed as percentage of live weight.

Economics of Diet

This was carried out as described by Ojewola *et al.* (2005).

Cost/kg of feed = $\frac{\text{total cost of producing 100kg of feed}}{100}$

Cost of feed consumed = cost/kg of feed X total feed consumed

Cost/kg weight gain = $\frac{\text{cost of feed consumed}}{\text{Total weight gain}}$

Cost of production = cost/kg weight gain X mean weight gain

Revenue = price of 1kg of meat X mean weight gain

Gross margin = Revenue – cost of production

ether extract, ash, NFE and metabolizable energy were within the same range for all the diets. The crude protein of the UMUCASS 36 foliage meal was the highest (25.38%) while the crude protein of the diets decreased as the level of inclusion of the foliage meal increased.

Results and Discussion

The determined proximate composition of the diets is as shown in Table 2. The dry mater,

Table 2: Determined proximate composition and gross energy of varied levels of processed UMUCASS 36 foliage meal supplemented with enzyme fed to broiler chickens

Parameters (%)	DIETS					UMUCASS 36 foliage
	T ₁	T ₂	T ₃	T ₄	T ₅	
Dry matter	89.97	89.48	89.32	89.10	88.80	86.14
Crude protein	24.50	24.50	22.75	21.88	21.00	25.38
Crude fibre	11.00	14.00	15.90	17.00	18.30	25.62
Ether extract	3.12	3.04	2.94	2.85	2.80	1.45
Ash	13.80	13.77	13.56	14.20	13.56	13.80
NFE	37.55	34.17	34.17	33.17	33.14	19.89
Metabolizable Energy (kcal/g)	3113.04	3192.07	3087.79	3047.98	2938.46	2953.12

The metabolizable energy followed the same trend as the crude protein in the diets. The result of this work is in concordance with the result of the determine composition of cassava foliage meal fed broiler chicken by Adedokun (2017).

Growth performance of broiler chickens fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

The Growth performance of broiler chickens fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme is showed in table 3. The final weight, average weight gained and average daily weight gained had the same

trend of significance (P<0.05) across the treatment groups. Broiler chickens fed diet 2 were significantly higher (P<0.05) than the remaining treatment groups. There was no significant difference in the results of the average feed intake and average daily feed intake of the birds. The feed conversion ratio showed that broiler chicken fed control diet (3.29) was higher and significantly different (P>0.05) from that of diets 2 (1.74), 3 (2.44), 4 (2.53) and 5(2.74). Diet 2 had the best feed conversion ratio while that of diets 3, 4 and 5 are comparable.

Table 3: Growth performance of broiler chickens fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

Parameters	DIETS					SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	
Initial wt. (g)	236.67	236.67	235.00	238.33	236.67	1.16
Final wt. (g)	2033.33 ^c	3366.67 ^a	2533.33 ^b	2466.67 ^b	2266.67 ^{bc}	127.49
Ave. wt. gain (g)	1796.67 ^c	3130.00 ^a	2298.33 ^b	2228.33 ^b	2030.00 ^c	127.77
Ave. feed intake (g)	5794.00	5416.33	5611.33	5605.33	5566.55	55.19
Ave. feed intake/bird/day (g)	118.24	110.54	114.52	114.39	113.59	1.13
Ave. daily wt. gain (g)	36.67 ^c	63.88 ^a	46.90 ^b	45.48 ^b	41.43 ^{bc}	2.61
Feed Conversion Ratio	3.29 ^a	1.74 ^c	2.44 ^b	2.53 ^b	2.74 ^b	0.15

Means within the same row with different superscript (^{a-c}) are significantly (P< 0.05) different. SEM-Standard Error of Mean

It was observed that weight gained and the feed intake decreased as the inclusion level of UMUCASS 36 foliage meal supplemented with enzyme increased across the treatment groups. This was the observation of Adedokun (2020) when broiler chicken was fed umucass 36 foilage meal. Wide variations had been observed between studies with regards to the success of feeding cassava meal to poultry. Early researchers, such as Khajarern and Khajarern (2007) and Aderemi *et al.* (2000) found encouraging results, likely due to increased awareness of how to balance the nutrients and the negative impact of HCN. Feed intake of cassava products was limited in poultry by the palatability of cassava-based diets, due to its dustiness and bulkiness (Buitrago *et al.*, 2002). This could be partially mitigated by processing the cassava-based diets further through pelleting or potential addition of molasses or fat to improve texture and reduce dustiness, whilst simultaneously supplying essential fatty acids.

Carcass characteristics of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

The carcass characteristics (expressed as percentage dressed weight) of broiler chicken fed

processed UMUCASS 36 foliage meal supplemented with enzyme is revealed in Table 4. There were significant differences ($P < 0.05$) in all the parameters considered. The result of the live weight showed that there was significant difference ($P < 0.05$) across the treatment groups where broiler chickens fed T₂ was significantly higher ($P < 0.05$) (3316.67g) than the remaining treatment groups. The dressed weight showed that there was significant difference ($P > 0.05$) between broiler chickens fed control diet (1283.33g) and diet 2 (2916.67g). Dressed weight in T₂ was significantly higher ($P > 0.05$) than the remaining treatment groups. The result of the dressing percentage showed that there was significant difference ($P > 0.05$) between broiler chickens. Birds on treatment two had the best dressing percentage. The breast showed that broiler chickens fed control diet (33.19) was significantly lower ($P < 0.05$) than those fed diet 2(35.76) and 3 (36.80) but was significantly higher ($P > 0.05$) from those fed diet 4 (32.07) and 5(31.13) respectively. The result of the thigh showed that broiler chickens fed diet 2, 4 and 5 were not significantly different ($P > 0.05$) from each other but they were significantly higher ($P < 0.05$) than those fed control diet and 3 respectively, while the drumstick and back cut showed no significant difference

Table 4. Carcass characteristics of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

Parameters	DIETS					SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	
Live wt.(g)	2000.00 ^c	3316.67 ^a	2433.33 ^b	2316.67 ^{bc}	2200.00 ^{bc}	127.19
Bled wt. (g)	2016.67 ^b	3016.67 ^a	2183.33 ^b	2150.00 ^b	2133.33 ^b	109.54
De-feathered wt. (g)	1783.33 ^c	2916.67 ^a	2116.67 ^b	2000.00 ^{bc}	2000.00 ^{bc}	109.48
Dressed wt. (g)	1283.33 ^c	2133.33 ^a	1583.33 ^b	1450.00 ^{bc}	1400.00 ^{bc}	83.07
% Dressed wt.	64.60 ^b	72.22 ^a	65.00 ^b	62.60 ^b	64.30 ^b	0.80
Cut parts (%)						
Breast	33.19 ^{ab}	35.76 ^{ab}	36.80 ^a	32.07 ^{ab}	31.13 ^b	0.78
Drumstick	15.18	15.19	15.03	17.01	16.43	0.39
Thigh	15.88 ^b	17.43 ^a	16.53 ^{ab}	17.70 ^a	17.45 ^a	0.25
Wings	13.01 ^{abc}	14.25 ^a	12.37 ^{bc}	13.46 ^{bc}	12.07 ^c	0.25
Back	20.37	21.01	20.69	20.46	21.14	0.28

Means within the same row with different superscript (^{a-c}) are significantly ($P < 0.05$) different. SEM- Standard Error of Mean

The wings showed that broiler chickens fed diet 2 (14.25) was significantly higher ($P<0.05$) than those fed diets 3, 4 and 5 but was comparable to broiler fed diet 1. The result of the dressed weight, dressed percentage and breast cut % showed that broiler chickens fed 10% had higher means values which indicates the potentials of UMUCASS 36 foliage meal supplemented with enzyme. Similar trend of result was observed by Adedokun (2020). This current result is in agreement with the studies of Ngiki *et al.* (2014) observed lower slaughter, plucked weights and dressing percentages as the cassava root leaf meal mixture increased which is line with the report of this work. This could be associated with the higher weight of the gut and

increased gut length which was due to high fibre content of the treatment diets compared to the other treatment groups.

Organ proportion of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

The organ proportion of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme is showed in table 5. The result of the spleen showed that broiler chickens fed diet 5 (0.12) was higher than those fed control diet, diet 2, 3 and 4 respectively, while the result of the heart and intestine showed that there were no significant differences ($P>0.05$) across the treatment groups.

Table 5. Organ proportion of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

Parameters (%)	DIETS					SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	
Spleen	0.10 ^{ab}	0.07 ^b	0.14 ^a	0.12 ^{ab}	0.12 ^{ab}	0.00
Heart	0.42	0.42	0.51	0.44	0.43	0.02
Liver	2.79 ^a	1.64 ^c	2.05 ^{ab}	2.24 ^b	2.05 ^{ab}	0.11
Gizzard	1.71 ^a	1.49 ^b	1.69 ^b	1.72 ^a	1.72 ^a	0.03
Kidney	0.93 ^a	0.46 ^b	0.55 ^b	0.67 ^{ab}	0.65 ^{ab}	0.06
Intestine	6.55	5.13	4.23	5.44	6.52	0.39
Proventriculus	0.50 ^a	0.34 ^b	0.39 ^{ab}	0.43 ^{ab}	0.50 ^a	0.02
Crop	0.54 ^b	0.37 ^b	0.47 ^b	0.40 ^b	0.74 ^a	0.03
Pancreas	0.40 ^a	0.23 ^b	0.27 ^{ab}	0.28 ^{ab}	0.34 ^{ab}	0.02

Means within the same row with different superscript (^{a-c}) are significantly ($P< 0.05$) different. SEM- Standard Error of Mean

The result of the liver showed that broiler chickens fed control diet (2.79) was significantly higher ($P<0.05$) than those fed diet 2 and diet 4 but they were not significantly different ($P>0.05$) from those fed diet 3 and 5 respectively. The result of the gizzard showed that broiler chickens fed control diet (1.71) was significantly higher ($P<0.05$) than those fed diet 2 and diet 3 but they were not significantly different ($P>0.05$) from those fed diet 4 and 5 respectively. The result of the kidney showed that broiler chickens fed control diet (0.93) was significantly higher ($P<0.05$) than those fed diet 2 and diet 3 but they were significantly different ($P>0.05$) from those fed diet 4 and 5 respectively while the proventriculus showed that broiler chickens fed control diet (0.50) was significantly higher ($P<0.05$) than those fed diet 2, 3 and diet 4 but not

significantly different ($P>0.05$) from those fed diet 5 respectively. The result of the crop showed that broiler chickens fed diet 6(0.74) was significantly higher ($P<0.05$) than those fed control diet (0.54), diet 2(0.34) diet 3 (0.39) and diet 4 (0.40) also significantly different ($P>0.05$) respectively while the pancrease showed that broiler chickens fed control diet (0.50) was significantly higher ($P<0.05$) than those fed diet 2 but not significantly different ($P>0.05$) from those fed diet 3 4 and 5 respectively. This observation is in line with the findings of Ukachukwu (2000) who said that the presence of anti-nutrients causes the enlargement leading to increase in weight of liver due to detoxifying activities. The increase in the size of gizzard could be attributed to increase in the quantity of less digestible fibrous materials in the diet

(Akinmutimi *et al.*, 2006). Increase in the metabolic activities of the kidney and heart due to anti nutritional factors have resulted to their increase in weight (Akinmutimi, 2004). The percentage weight of small intestine, lungs, large intestine proventriculus, crop, pancreas, length of small intestine and large intestine followed the same trend as observed for other organs mentioned above. The increasing levels of anti-nutritional factors and fibre level could be said to be responsible for these.

Economics of production of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

Economics of production of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme is showed in table 4.5. The result of cost/kg feed showed that broiler chickens fed diet 5 (227.07) was significantly higher ($P < 0.05$) than those fed diet 2 and diet 4 but they were not significantly different ($P > 0.05$) from those fed diet 3 and 5 respectively.

Table 6: Economics of production of broiler chicken fed graded levels of processed UMUCASS 36 foliage meal supplemented with enzyme

Parameters	DIETS					SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	
Cost/kg of feed (₦)	193.27 ^e	201.87 ^d	210.17 ^c	218.64 ^b	227.07 ^a	3.19
Cost of feed consumed (₦)	1119.86 ^{cd}	1093.45 ^d	1179.39 ^{bc}	1225.55 ^{ab}	1264.00 ^a	19.53
Cost/kg wt. gain (₦)	109.80 ^a	64.68 ^c	91.49 ^b	98.43 ^{ab}	111.93 ^a	4.97
Cost of production (₦)	1119.86 ^{cd}	1093.45 ^d	1179.39 ^{bc}	1225.55 ^{ab}	1264.00 ^a	19.53
Revenue (₦)	1796.67 ^c	3130.00 ^a	2298.33 ^b	2228.33 ^b	2030.00 ^{bc}	127.77
Gross Margin (₦)	676.80 ^c	2036.55 ^a	1118.94 ^b	1002.78 ^{bc}	765.99 ^{bc}	137.09

Means within the same row with different superscript (^{a-e}) are significantly ($P < 0.05$) different. SEM-Standard Error of Mean

There were significant differences ($P < 0.05$) in all the measured parameters. The control diet (T1) with no cassava inclusion was the lowest (₦193.27) of all. The cost per kilogram of feed increased with increase in level of cassava inclusion from diet T2 (₦201.87) to diet T5 (₦227.07). This implied that inclusion of cassava in broiler diet would increase cost of production. Diets T1 (₦1119.86) and T2 (₦1093.45) had similar cost of feed consumed and cost of production but significantly different from diets T3 (₦1179.39), T4 (₦1225.55) and T5 (₦1264.00) which were also similar. Diet T2 has the least cost/kg weight gain of ₦64.68 and it was significantly different ($P < 0.05$) from other diets which were comparable.

Broilers on diet T2 gave the highest revenue and gross margin followed by T3, T4, T5 and T1 respectively. With broilers on diet T2 having the least cost/kg weight gain, best revenue and gross margin it could be said that 2.5% inclusion of

processed UMUCASS 36 foliage meal supplemented with enzyme in replacement of soya bean meal would give the farmer good income in broiler production. Feed cost per kilogram weight gain was best at 75% level of inclusion in Ngiki *et al.* (2014) experiment while in this study 2.5% inclusion level gave the best. This variance in percentage could be attributed to different ratio of the cassava leaf meals used by the researchers. The revenue and gross margin was best at broilers fed diet T2 (₦1740.67 and ₦1322.95 respectively) followed by broilers on diet T1 while others decreased progressively. Onyimonyi and Ugwu (2007) observed that the feed cost/bird was lower in the cassava peel/bovine blood based diets than in the control of their study. Similarly, revenue from cassava peel/bovine blood based diets was higher than the control which was in line with this study. It followed therefore that feeding broiler chickens diets based on processed UMUCASS 36 foliage

meal supplemented with enzyme improved savings. They are cheaper feedstuffs than soybean meal. This explained the reduction in cost and the high revenue from the birds fed the processed UMUCASS 36 foliage meal supplemented with enzyme diets.

Conclusion and Recommendation

In conclusion, looking at the growth performance, carcass characteristics, organ proportion and economics of production, birds in treatment 2 gave the best result. It can then be recommended that cassava foliage meal (2.5%) supplemented with enzymes at 0.2g/kg can be used successfully to raise broiler chickens.

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