PERFORMANCE, CARCASS CHARACTERISTICS AND ECONOMIC ANALYSIS OF BROILER CHICKENS FED DIETS CONTAINING ENZYME (*FULLZYME*)

Marte, U. M.[2], Lawan, I.[1], Idris, K. K.[2], Ahamed A.[2], Dantani, M[1]., and Tukur, M. A.[3]
Lawan020@gmail.com Tel: +234 8065291101
[1]Department of Animal Science, University of Maiduguri, Maiduguri. Borno State, Nigeria.
[2]Department of Animal Health and Production, Mohamet Lawan College of Agric, Maiduguri.
3National Agricultural Extension and Research Liaison Service, Ahmadu Bello University, Zaria.

ABSTRACT
This study was carried out to assess the effect of exogenous dietary enzyme supplementation on the performance of broiler finisher chickens under a hot dry environment. A total of two hundred and twenty five (225) unsexed *Anak Giant* strains of broiler chickens were randomly allotted to five dietary treatments, with 0, 125, 250, 375, and 500 mg/kg enzyme supplementation. Each treatment was replicated three times, with fifteen (15) birds per replicate in a completely randomized design. The experiment lasted for thirty (30) days. Feed and water were given *ad-libitum*. No significant (P>0.05) difference was observed with regards to feed intake, live weight gain and feed conversion ratio among all the treatment groups. Carcass characteristics and organs weights were not significantly (P>0.05) different for all the components. However, the neck, thighs, shanks and back were significantly higher among the treatments. The liver, lungs, and kidneys weights significantly (P<0.05) higher in all the treatment groups. Nutrient digestibility, CP and CF were significantly higher in T_3 than T_5 while CF was digested significantly (P<0.05) higher rate in control than any of the treatment groups. The cost benefit analysis showed that 375mg/kg enzyme supplemented diet had the heaviest final weight (1777.4) gain at the cost of ₦72.66k in the finisher phase, while the least weight gain (1347.7) at the cost of ₦72.03/kg was obtained in T_2 (125mg/kg) enzyme supplementation. This implies that, enzyme (*Fulzyme)* supplementation at 125 to 500mg/kg did not improve broiler performance.

INTRODUCTION
The poultry industry during the past decades has been one of the most dynamic and ever-expanding sectors in the world (Alkhalf *et al.*, 2010). Livestock especially poultry production seem to be recognized as the fastest industry which can overcome the animal protein deficiency especially in third world countries due to the short generation interval, high turnover rate and economic efficiency (Inuwa *et al.*, 2020). A number of feed additives such as antibiotics, vitamins, minerals and probiotics other growth promoters are being used to improve animal performance especially broiler chickens (Ndelekwute *et al*., 2015). Enzymes have been approved for use in poultry feed because they are natural products and pose no threat to the animal or consumer (Vukic-vrangez and Wenk, 1993). Their use in poultry feeds has predominantly been related to the hydrolysis of fibre or non-starch polysaccharide (NSP) fraction of cereal grains. Exogenous enzymes have been used extensively in the diets of poultry to improve productive performance and nutrient utilization (Oladipo *et al.*, 2015). Various supplements of exogenous enzymes have been used in Poultry diets to improve feed efficiency and utilization. However, exogenous enzymes are capable of degrading non-starch polysaccharides (NSP) in broiler diets based on viscous grains, including wheat and barley. *Fullzyme*® is a multi-enzyme compound of α-glucanase, xylanase and phytase produced by a unique batch fermentation process which originated from the bacteria *Bacillus subtilis*. The objective of this study was to evaluate effect of dietary enzyme (*Fullzyme*) supplementation on the performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS
The experiment was conducted at the poultry unit of the Teaching and Research farm, Mohamet Lawan College of Agriculture Maiduguri, Borno State. Maiduguri is located between latitude 11^0 5 and 12^0 North and longitude 13^005 and 14^0 East at an altitude of 353 M above sea level (Adamu *et al.*, 2001). Maiduguri is a typical Semi arid environment. Diurnal temperature of $>35^0$C is not uncommon for most part of the year.

A total of two hundred and twenty five 225 *Anak* giant strain of broiler chicks were used for this experiment. Five finisher experimental diets were formulated containing graded levels of the dietary enzyme (*Fullzyme*). The experimental diets contained 0, 125, 250, 375 and 500 mg/kg of the enzyme in

Table1: Ingredient Composition and calculated analysis of the experimental broiler finisher diets

	Various levels of enzyme inclusion**				
	T_1	T_2	T_3	T_4	T_5
Ingredients (%)	0mg	125mg/kg	250 mg/kg	375 mg/kg	500 mg/kg
Maize	53.63	53.63	53.63	53.63	53.63
Wheat offal	8.00	8.00	8.00	8.00	8.00
Groundnut cake	16.37	16.37	16.37	16.37	16.37
Soya bean meal	12.00	12.00	12.00	12.00	12.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Blood meal	1.00	01.00	01.00	01.00	01.00
Bone meal	3.00	03.00	03.00	03.00	03.00
Mineral/Vitamin	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	00.30
NaCl	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analyses					
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
Crude fibre (%)	3.40	3.40	3.40	3.40	3.40
Calcium	0.9	0.9	0.9	0.9	0.9
Phosphorus	0.89	0.89	0.89	0.89	0.89
ME (Kcal/kg)	2811.6	2811.6	2811.6	2811.6	2811.6
EPR	122.2	122.2	122.2	122.2	122.2

ME= Metabolizable energy
EPR= Energy protein ratio
** Bio mix Broiler Starter supplying the following per kg feed. Vitamin A = 3,400,000IU Vitamin D_3 = 6,00,000IU, Vitamin E = 4000mgVitamin K_3 = 600mg, Vitamin B = 640mg,Vitamin B_2 = 1600mg, Niacin= 8,000mg,pantothenic = 2000mg, Vitamin B_6 = 600mg, Vitamin B_{12} = 4mg, Folic acid = 200mg, BiotinH_2 = 300mg, Choline = 70,000mg, Cobalt = 80mg, Copper = 1200mg,Iodine = 400mg, Iron=8,000mg, Manganese = 16,000mg,Selenium = 80mg, zinc = 12,00mg, and Anti-oxidant= 600mg,*

T_1, T_2, T_3, T_4 and T_5 respectively, which corresponds to 0, 5, 10, 15, and 20% presented in Table 1. Each treatment (T) was replicated three times, with fifteen (15) birds per replicate in a completely randomized design. The experiment lasted for 30 days for the finisher phase. Data were generated for feed intake, live weight gain, feed conversion ratio, nutrient digestibility, and carcass characteristic. Feed and water were given *ad-libitum*. Three (3) representative birds from each treatment, were selected (based on average weight) of the group for carcass analysis.

Statistical Analysis: Data collected were subjected to analysis of variance using Completely Randomized Design (CRD) (Steel and Torrie, 1980). Significant differences among treatment means were compared using Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSION

The productive performance of the broiler chickens supplemented with enzyme is presented in Table 2. The values recorded for final live weight showed no significant (P>0.05) differences among all the treatment groups, with T4 recording the highest value (1777.4 g) while T2 lower value (1347.7 g). Feed intake values observed were 114.85, 107.01, 109.03, 112.30, and 108.21g for T_1 to T_5, respectively, however revealed no significant (P>0.05) differences among the treatment groups. These values were lower than mean values of 183.18 to 188.52 g/bird, reported by Ndelekwute *et al.* (2015) who fed maize-soya bean diet containing acetic acid and enzyme on growth performance of broilers. The mean daily weight gain ranged from 29.67 to 32.71g/bird/day. Birds on T_4 recorded superior weight gain value (32.71g) over other treatments, while birds on T_3 had the least weight gain (29.67g/bird). The FCR values were similar for all the treatment groups and were higher than the values (1.83 to 2.21) reported by Ndelekwute *et al.* (2015) which indicate lower efficiency and utilization of feed.

Table 2. Productive performance of broiler finisher chickens supplemented with enzyme

	Treatments/Diets					
Parameters **	T_1(0mg/kg)	T_2(125mg/kg)	T_3(250mg/kg)	T_4(375mg/kg)	T_5(500mg/kg)	SEM
Initial weight (g/bird)	456.47	394.77	419.43	469.20	452.40	- - -
Final live weight (g/bird)	1574.8	1347.7	1576.7	1777.4	1582.0	142.0^{NS}
Mean feed intake (g/bird)	114.85	107.01	109.03	112.30	108.21	13.00^{NS}
Daily weight Gain (g/bird)	30.23	31.76	29.67	32.71	29.72	8.76^{NS}
Feed conversion ratio	3.79	3.45	3.67	3.43	3.64	NTS
Mortality (number)	07	06	06	05	07	NTS

NS = Not significant , SEM = Standard error of means, NTS = Not tested statistically

Carcass Characteristics and Organ Weights

The results of carcass characteristics and organ weight measurements are presented in Table 4.5. The values obtained were significantly higher (P<0.05) for the shanks, neck, thigh, back liver, lungs kidneys respectively. The liver value (2.47g) recorded was significantly (P<0.05) higher in T_5 while T_4 has the least value (1.99g), however, these values are similar to the values reported by Sogunle *et al.* (2010). The lungs value was significantly higher (P<0.05) with a value of 0.85 in T_5 while the least value (0.41) was recorded in T_1. The kidneys were significantly (P<0.05) higher in T_4 with a value of 0.65 while T_1 has the least value of (0.17) respectively and higher than the values reported by Iyayi *et al.* (2006) who fed three different sources of fibre to broiler chickens. This implied that nutritional intervention of exogenous enzyme up to 500mg/100kg in the diets of broiler chickens has no positive effect on carcass composition which led to poor performance of birds.

Table 3. Carcass characteristics and organ weights of broiler chickens supplemented with enzyme

	Treatments/Diets					
Parameters	T_1(0mg/kg)	T_2(125mg/kg)	T_3(250mg/kg)	T_4(375mg/kg)	T_5(500mg/kg)	SEM
Live weight (g)	1574.80	1347.70	1576.70	1777.70	1582.00	189.3^{NS}
Dressed weight (g)	1020	1008	1214	1400	1095	121.7^{NS}
Dressing percentage	64.8	74.8	76.9	78.7	69.2	1.826^{NS}
	Cut-up parts expressed as % of slaughter weight (%)					
Head	1.80	2.30	2.10	2.17	2.30	0.182^{NS}
Shanks	3.80^{b}	4.30^{ab}	3.80^{b}	4.47^{a}	4.53^{a}	0.201*
Neck	4.93^{bc}	6.07^{a}	4.60^{c}	6.13^{a}	5.90^{ab}	0.314*
Wings	8.13	8.20	7.87	7.47	7.60	0.247^{NS}
Thighs	9.63^{c}	11.93^{a}	10.93^{b}	12.40^{a}	11.57^{ab}	0.309*
Drumsticks	9.70	10.17	9.90	10.23	10.07	0.377^{NS}
Breast	18.70	18.00	18.63	17.97	18.47	0.836^{NS}
Thorax	6.60	5.77	6.57	5.97	5.90	0.365^{NS}
Back	9.96^{a}	9.60^{ab}	9.56^{ab}	7.41^{ab}	8.39^{b}	0.783*
	Organ and other visceral components as % of slaughter weight					
Heart	0.52	0.49	0.39	0.41	0.29	0.075^{NS}
Empty Gizzard	2.03	2.36	1.97	2.13	2.18	0.142^{NS}
Liver	2.01^{b}	2.06^{ab}	2.41^{ab}	1.99^{b}	2.47^{a}	0.135*
Lungs	0.41^{b}	0.77^{a}	0.79^{a}	0.81^{a}	0.83^{a}	0.063*
Complete intestine	6.33	6.45	6.03	5.65	5.99	0.482^{NS}
Kidney	0.17^{c}	0.43^{b}	0.14^{c}	0.65^{a}	0.23^{c}	0.052*
Proventriculus	6.40	5.63	5.37	5.47	5.70	0.493^{NS}
Abdominal fats	1.68	1.44	1.50	1.24	1.57	0.239^{NS}

abc = means in the same row bearing different superscripts differ significantly (P>0.05)
NS = Not significant (P>0.05) SEM = Standard error means * = Significant (P<0.05)

Nutrient Digestibility of Broiler Chickens

The results of nutrient digestibility of broiler chickens supplemented with different levels of exogenous enzyme are presented in Table 4. The results recorded for (DM) and ash showed no significant (P>0.05) difference among all the treatment groups with ranges of 63 to 72% and 51 to 88% for DM and Ash, respectively while CP, CF, EE and NFE revealed significant (P>0.05) difference among all treatment groups. These significant values obtained were lower than values

reported by Alabi *et al.* (2014) who fed rice husk supplemented with commercial enzyme on the performance of broiler chickens but were similar to the values reported by Iyayi *et al*. (2005).

Table 4. Nutrient digestibility of broiler finisher chickens supplemented with enzyme

	Treatment/Diets					
Nutrients (%)	T_1(0mg)	$T_{2(125mg)}$	$T_{3(250mg)}$	$T_{4(375mg)}$	$T_{5(500mg)}$	SEM
Dry matter	72	66	63	67	69	5.12^{NS}
Crude Protein	76^{a}	68^{ab}	58^{b}	68^{ab}	76^{a}	7.72^{*}
Crude Fibre	49^{b}	$58a^{b}$	$62a^{b}$	53^{b}	66^{a}	4.75^{*}
Ether Extract	44^{b}	88^{a}	81^{ab}	87^{a}	84^{ab}	3.75^{*}
Ash	51	70	88	67	69	8.5^{NS}
NFE	54.45^{ab}	53.41^{ab}	51.83^{ab}	66.91^{a}	43.87^{b}	3.75^{*}

a,b = Means in the same row bearing different superscripts differ significantly (P<0.05), NS = Not Significant (P>0.05) SEM = Standard Error of Means, *= Significant (P<0.05), NFE = Nitrogen free extract

However, the highest CP digestibility was recorded in T_1 and T_5 (76%), while the least value was recorded in T_3. Crude fibre digestibility was highest (66%) in T_5 and lowest in (49%) in T_1. Nitrogen free extract digestibility was highest in T_4 (66.91%) while the least value (43.87%) was observed in T_5. This observation is in line with the report of Hanson (2014) who reported that NSP, oligosaccharides and phytates were the major targets of enzyme. Therefore, supplementation of enzyme (*fullzyme*) to broiler chickens produced from *Bacillus subtilis* at a rate of 375 mg/100kg on nutrient utilization revealed positive effect thus, increasing energy availability which manifested on growth performance and digestibility.

Table 5. Cost benefit analysis of broiler finisher chickens supplemented with *fullzyme*

	Diets/Treatments				
Parameters	T_1(0mg/kg)	T_2(125mg/kg)	T_3(250mg/kg)	T_4(375mg/kg)	T_5(500mg/kg)
Initial live wt (g)	456.47	394.77	419.43	469.20	452.40
Final weight (g)	1574.80	1347.70	1576.70	1777.40	1582.00
Total weight gain (kg/bird)	1118.33	952.93	1157.27	1308.20	1129.60
Daily wt gain (g)	30.23	31.76	29.67	32.71	29.72
Total feed intake (kg/bird)	114.85	107.01	109.03	112.30	108.21
Feed cost/kg (₦)	71.72	72.03	72.35	72.66	72.97
Total feed Cost (₦)	7172.00	7203.00	7235.00	7265.98	7297.23
Cost/kg gain (₦)	547.60	593.40	547.60	415.20	578.70

Cost per kilogram of the various ingredients used in compounding the experimental diets; Maize ₦70.00, wheat offal (₦)50.00, fish meal ₦130.00, soya bean meal ₦120.00, groundnut cake ₦100.00, bone meal ₦50.00, blood meal ₦30.00 vitamins and minerals premix ₦600.00, methionine ₦1000.00, and sodium chloride ₦45.00. NB; based on the prevailing price in Maiduguri at the time when the experiment was conducted (December-February 2015/2016).

Cost Benefit Analysis of Broiler Chickens

The cost benefit analysis is presented in Table 5. Diet 1 served as control containing zero enzyme while diets 2, 3, 4, and 5 contained enzymes at a cost of ₦31.25, ₦62.50, ₦93.75 and ₦125, respectively per 100kg, cost of production increases with enzyme supplementation level in diets, which implies that cost of formulation increases across treatments as enzyme inclusion increased and is in line with the report of Inuwa *et al*., (2020). T_4 recorded the heaviest weight (1777.4g) followed by T_5 (1582), T_3 (1576.7g), T_1 (1574.8g) and T_2 (1347.7g), respectively. These results observed in this study revealed that the enzyme (*fullzyme*) used was unable to unveil bound nutrients to chickens with better performance at least cost.

CONCLUSION

This study concluded that supplementation of enzyme (*Fullzyme*) at the rate of 500mg/kg in broiler finisher diet has no positive effect on the productive performance and carcass characteristics. This is an indication that inclusion of *fullzyme* in maize-soya bean based diet is not necessary.

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