Growth performance and nutrient digestibility by broiler starter chicks fed dried *Tridax procumbens* meal-based diets supplemented with fullzyme

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Abstract
48 days feeding trail was conducted to evaluate the effect of dried *Tridax procumbens* and fullzyme supplementation on the growth, nutrient digestibility and production economics of broiler starter. The experiment was conducted with 240 day-old hub bard broiler chicks were divided into 6 treatments 4 replicates and 10 birds per replicate. Birds were randomly allotted to a six dietary treatment T_1, T_2, T_3, T_4, T_5, and T_6 and compounded to be isocaloric ranges from (2800kcal/kg) and isonitrogenous (24.00% CP) and were arranged in a 2x3 factorial fitted into Completely Randomized Design with 2 levels of *Tridax* (0 and 5%) and fullzyme at (0, 100 and 200ppm). Feed and water were provided to the animals daily and all standard routine management practices were strictly observed. The result showed reduction in final weight gain (617.91g/bird), weight gain (20.69g/bird), PER (2.42), revenue (741.50₦) and gross margin (189.87₦) for birds fed 5% SDTPM than those fed on 0%. However, FCR (2.33) and FC/kg WG (333.65₦/bird) were higher on 5% SDTP than those fed 0% SDTPM. Enzyme supplementation increase FCR (2.30 and 2.24), FC/kg WG (332.50 and 324.99₦/bird) and (547.89 and 556.49₦/rabbit) for bird fed 100 and 200ppm than those fed 0ppm enzyme. Interactive effect of SDTP and enzyme increased most of the parameters measured for birds fed T3 (0% SDTP+200ppm). Sundried *Tridax procumbent* did not influence nutrient digestibility of starter birds. However, dry mater (67.41%) and NFE were improved due to enzyme addition for bird fed 100ppm than 0 and 200ppm. Interaction increase dry matter for bird fed T2 and T5 (67.41%) only.
Keywords: Digestibility, Economics, Enzymes, Growth, *Tridax procumbent*

Introduction

Most developing countries of the world including Nigeria are plagued with food crises probably due to rise in human population. This problem of increasing human population is further aggravated by the attendant competition between man and livestocks for existing feedstuffs such as cereal and leguminous grains and tubers (FAO, 2013). Increase in human population is generally accompanied by increased demand for food by both man and livestock leading to wider animal protein intake gap; animal protein is superior to plant protein in human nutrition (Akinmutini, 2004). Akinmutini (2004) also reported that poultry production has served to meet the requirement of the population through meat and egg and also provide sources of income. Broiler chickens remain the fastest source of animal protein because of the rapid growth due to their genetic composition and ability to efficiently utilize feed (Akinmutini, 2004). Agriculture contributes to the growth of production of animal protein in particular through the promotion of short-cycle species of livestock in general, especially poultry. Thus, poultry farming is one of the tracks on which the countries of West Africa should undertake to increase production of animal proteins (Leroy and Lebailly, 1999).

Feed is the most important input in a profitable poultry production. It accounts for 70-80% of the total cost of production (Ogundipe, 1987; Kehinde *et al*., 2006). FAO (2013) recommended a minimum protein intake level of 58g per day out of which 35g should be of animal origin, but most Nigerians eat less than 20g of protein per day thus, the incidence or condition of malnutrition (Taiwo *et al.,* 2006). Taiwo *et al.* (2006) also reported that serious malnutrition has been reported among children and pregnant women of the low/poor class people that form the majority in the society. Poultry products can significantly improve the nutritional and health status of most people especially the children. The supply of animal protein in human diet is important since it provides essential amino acids particularly lysine, methionine and B-vitamins which the body cannot synthesize from vegetable source (Aduku and Olukosi, 2000).

Materials and Methods

Experimental site

The study was conducted at the Livestock Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus. It is located in the Guinea Savannah Zone of the North Central Nigeria. It is located on latitude $08^0$35'N and longitude $08^0$33'E. The mean monthly temperature is 35.06c and means monthly relative humidity of 74%. The dry season is between November and March and rain peak occurs around August. The annual rainfall is about 168.90mm and the vegetation type is dominated by savannah trees and small woody shrubs (NIMET, 2017).

Proximate analysis of *Tridax procumbent*

Proximate composition (crude protein, dry matter, ether extract, crude fiber and nitrogen free extract) of the experimental test ingredient were determined using the procedure outlined by (AOAC, 2010) as described by (Alu, 2012) and the results were presented in Table 1.

Feed ingredients, animals and experimental design

The *Tridax procumbens* (TP) was collected locally from the rural farms in Nasarawa Eggon local government Area of Nasarawa State, Nigeria. The whole plant consisting of stems, leaves and roots was shade dried according to the procedure adopted by Alagbe (2017) and milled into powder with a hammer mill; and then stored in polythene bags. Exogenous enzymes were purchased from a reputable feed additive shop. while other ingredients such as maize, soya beans , maize bran, rice bran, groundnut cake, fish meal, bone meal lysine methionine were purchased from the suppliers in Lafia, Nasarawa State. A total of 240 day-old hub bard broiler chicks were used for the research. The birds were randomly allocated into 6 dietary treatments with 10 birds per replicate using a 2x3 factorial design. Each treatment was replicated 4 times and formulation of feed was done using feed win software. Diet 1 (control) was compounded using 0% TP with 0ppm Enzyme. Diets T2 and T3 have 0% TP with 100 and 200ppm enzyme, respectively. While T4, T5 and T6 was compounded using 5% TP with 0, 100 and 200ppm enzyme respectively. The treatment diets contained 20% crude protein (CP) for the finisher phase, all experimental birds was given feed and water *ad-libitum* throughout the experimental period.

Parameters measured

Growth performance indices

The quantity of feeds was measured daily and recorded before given to the birds. The quantity of leftover in the feeders was deducted from the feed served in the previous day and measured as feed intake for the day. Feed intake was recorded per replicate and values recorded were used to compute the average weekly feed intake. The average weekly intake were divided by the number of birds and further divided by seven for average feed intake per bird per day. The performance data was measured for both starter and finisher phases were:

(a) Daily feed intake: The animals were given a weighed amount of feeds and their corresponding left over were weighed and recorded. Daily feed intake shall therefore obtained as the difference between the amount of feed fed and the left over. Thus, feed intake = feed offered – feed left over.

(b) Body weight again (BWG): This is measured by the difference between the final weight and the initial weight of the animal. Thus, it is expressed as weight gain= final weight – initial weight

(c) Feed conversion ratio (FCR): This was calculated as feed intake divided by body weight gain $FCR = \frac{FI}{BWG}$

(d) Protein intake (P1): This is expressed as percent crude protein (CP) of diet multiplied by feed intake (FI) i.e. PI = $\frac{\%\,CP\ of\ diet \times FI}{100}$

(e) Protein efficiency ratio (PER); This was determined as protein intake divided by the weight gain PER = $\frac{PI}{BWG}$

Economics of production

The parameters of economics of production were included as followings:

Cost of feed per kilogram (kg)

Cost of feed per unit weight grain: These were computed as the cost of feed divided by weight gain.

Profit: These were calculated as the total market value of bird minus total cost of production.

Cost of production: These costs of production were estimate as the cost of the chicks and feed consumed throughout the period of the experiment.

Revenue: The revenue was calculated as price of bird multiplied by mean total weight gain per bird.

Gross margin: The gross margins were estimated as the difference between revenue and cost of production.

Nutrient digestibility

Metabolic study was conducted by moving selected birds from each treatment into metabolic cages on the twenty-eighth day of the finisher phase to determine dietary nutrient utilization of the broiler finisher. Two broiler finisher with average weight similar to the group average were selected from each replicate.

Birds were allowed adjustment period of three days and thereafter were fed with weighed diets daily for four days. The left over feed was weighed to determine feed intake by difference. Wet faecal dropping per replicate was collected daily; weighed and oven dry at 105^0c to 10% moisture. Faecal sample per mill and analyzed for nutrient composition and gross energy content using the procedure of AOAC (1995). Nutrient retained was determined as nutrient intake minus nutrient voided in the faeces.

Digestibility coefficient was calculated using the formulae $D = I = \frac{F}{I} \times 100$ where D = digestibility coefficient, I = nutrient intake and F= nutrient voided in the faecal material (Aduku, 2004).

Statistical analysis

Data collected were subjected to two way analysis of variance (ANOVA) for factorial experiment using (SPSS, 2007) Model. Significantly different means were separated using Duncan's Multiple Range Test (Duncan 1955). The following statistical model was used: Y_{ijk}= U +A_I +B_J + $(AB)_K$+e_{ijk} where Y_{ijk}=individual observation, U= population mean, A_i = effect of factor A, B_j= effect of factor B, and AB_K = effect of interaction of factor A&B.

Result and Discussion

The effect of shade dried *Tridax procumbens* on growth performance and production economics of broiler starter is presented in Table 2. The result indicated that final body weight 660.00 and 617.91g/bird, weight gain 22.19 and 20.69g/bird, and PER 2.77 were significantly (P<0.05) reduce in birds fed 5% SDTP compared to the 0% SDTP. However, FCR (2.13 and 2.33) significantly increased as the level of SDTP increase in the diets. Initial weight, feed intake and EER were not significantly (P>0.05) affected by the inclusion of SDTP. This observed to be associated with presence of higher fibre value of the diets which hinder the growth of younger birds. This observation disagree with the previous report of Mmerede *et al.* (2011) who studied the growth performance and cost analysis of weaner rabbit fed varying dietary levels of crude protein supplemented with *Tridax procumbens* leaf meal and reported significant (P<0.05) increase in feed consumption, body weights and weight gains, FCR, and revealed that rabbits fed concentrate diets containing 14%+CP+ *Tridax* supplement had the best feed conversion ratio, least production cost/per kg of body weight gain.

The effect of enzyme supplementation on growth performance and production economics of broiler starter is presented in Table 3. The result showed significant (P<0.05) increase in the FCR (2.14, 2.30 and 2.24) for birds fed on 100 and 200ppm enzyme supplementation than other birds fed on 0ppm. This observation were in consonant with the earlier work of Duru and Dafwang (2010) who investigated Maxigrain® enzyme supplementation of diets with or without rice offal on performance of broiler chicks and noted no significant variation in final body weight but feed consumption was increased significantly due to rice offal inclusion. In this study, chicks fed on fermented diets ate significantly higher than those fed on non-fermented diets.

Similarly, the interactive effect of shade dried *Tridax procumbens* and enzyme supplementation on growth performance and production economics of broiler starter chicks is presented in Table 4. The result showed significant (P<0.05) increase in the final weight (667.50g/bird), weight gain (22.46g/bird), better FCR (2.13) and EER (21.90) for birds fed on T3 (0%TP +200ppm) than the control and other treatments diets. However, feed intake increased (49.47g/bird) at T6 (5%TP+200ppm) while other parameters were not significantly (P>0.05) affected due to interaction. This is contrary with the previous report of Bello *et al.* (2001) who studied the performance of weaner rabbits fed varying levels of *Tridax procumbens* and reported significant (P<0.05) increase in the dry matter intake of rabbits fed dried *Tridax procumbens* meal upto 45% without any adverse effect in their performance.

The effect of shade dried *Tridax procumbens* on apparent nutrient digestibility of broiler starter chicks is presented in Table 5. The result indicated that dry matter (66.98 and 66.73%), crude protein (66.63 and 58.08%), ether extract (68.87 and 69.62%), crude fibre (59.32 and 60.44%), ash (63.51 and 62.94%) and nitrogen free extract (68.74 and 69.79%) were not significantly (P>0.05) affected due to SDTP inclusion levels.

The effect of enzyme supplementation on apparent nutrient digestibility of broiler starter chicks is shown in Table 6. The result showed significant (P<0.05) increase in nutrient digestibility of dry matter (66.99, 67.41 and 66.16%) and nitrogen free extract (68.43, 72.77 and 66.60%). Birds fed 100ppm had higher dry matter and NFE than 0 and 200ppm, respectively. The significant increase in nutrient digestibility of dry matter and nitrogen free extract for birds fed 100ppm were attributed to the addition of enzymes in the diets which supported the earlier work of Adeola and Olukosi (2008) who stated that utilization of dietary fibre in monogastric animals can be improved by exogenous enzymes supplementation.

The interactive effect of shade dried *Tridax procumbens* and enzyme supplementation on apparent nutrient digestibility of broiler starter is shown in Table 7. The result indicate significant (P<0.05) improvement in nutrient digestibility of dry matter (67.41%) at T2 and T5 than control and other treatment diets. This is in agreement with the earlier submission of Alu *et al.* (2009) who investigated the effect of Nutrase xyla enzyme supplementation on nutrient digestibility where high and low fibre were fed to weaner pigs resulted in significant improvements in the digestibility of neutral detergent fibre and hemicellulose.

Conclusion and Recommendation

It is concluded that sundried *Tridax procumbens* reduce broiler performance for the starter chicks. However, enzymes supplementation at 100ppm with 5%SDTP had increase growth and economics returns. Similarly, SDTP had not negative effect on nutrient digestibility of broiler starter chicks.

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Table 1: Proximate Composition of *Tridax procumbens*

Parameters	(%)
Crude protein (CP)	7.03
Crude fat (EE)	2.29
Crude fibre (CF)	32.21
Ash	5.37
*NFE	41.14
*Energy (ME kcal/kg)	1906.299

*NFE=100 - % (CP + CF + EE +ASH+ MOISTURE), (AOAC, 2010) d. *(pauzanga, 1985); ME=37 x % CP+81.1 x % EE+35.5 x % NFE

Table 2. Effect of shade dried *Tridax procumbens* on growth performance and production economics of broiler starter

PARAMETERS	SDTP INCLUSION LEVELS (%)			
	0% SDTP	**5% SDTP**	**SEM**	**LOS**
Initial body weight (g/rabbit)	38.275	38.267	0.046	NS
Final body weight (g/rabbit)	660.00a	617.91b	12.81	*
Weight gain (g/rabbit/day)	22.19a	20.69b	0.45	*
Av. Feed intake (g/rabbit/day)	47.01	48.14	0.54	NS
Av. FCR	2.13b	2.33a	0.042	*
PER	2.77a	2.423b	0. 07	*
EER	21.64	20.720	0.45	NS
FC/kg	145.63	143.04	-	-
FC/kg WG	310.19b	333.65a	6.03	*
TCP	551.70	551.62	2.07	NS
REV	792.00a	741.50b	15.38	*
Gross Margin	240.29a	189.87b	14.72	*

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05); Av= average; FCR= feed conversion ratio; PI= protein intake; PER= protein efficiency ratio; EER= energy efficiency ratio; FC/kg= feed cost per kilogram; FC/kgWG= feed cost per kilogram weight gain; TCP= total cost of production; REV= revenue.

Table 3. Effect of enzyme supplementation on growth performance and production economics of broiler starter

PARAMETERS	ENZYME SUPPLEMENTATION (PPM)				
	0ppm	100ppm	200ppm	SEM	LOS
Initial body weight (g/rabbit)	38.30	38.23	38.27	0.05	NS
Final body weight (g/rabbit)	657.50	612.50	646.87	15.70	NS
Weight gain (g/rabbit/day)	22.10	20.50	21.72	0.56	NS
Av. Feed intake (g/rabbit/day)	47.36	46.88	48.49	0.66	NS
Av. FCR	2.14b	2.30a	2.24ab	0.05	*
Av. PER	2.63	2.65	2.50	0.09	NS
Av. EER	21.77	20.20	21.56	0.55	NS
FC/kg	143.75	144.25	145.00	0.00	NS
FC/kg WG	308.26b	332.50a	324.99ab	7.387	*
TCP	550.61ab	547.89b	556.49a	2.53	*
REV	789.00	735.00	776.25	18.84	NS
Gross Margin	238.38	187.10	219.75	18.03	NS

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05); Av= average; FCR= feed conversion ratio; PER= protein efficiency ratio; EER= energy efficiency ratio; FC/kg= feed cost per kilogram; FC/kg WG= feed cost per kilogram weight gain; TCP= total cost of production; REV= revenue.

Table 4. Interactive effect of shade dried *Tridax procumbens* and enzyme supplementation (interaction) on growth performance and production economics of broiler starter

PARAMETERS	INTERACTION TREATMENT							
	T1	T2	T3	T4	T5	T6	SEM	LOS
Initial body weight (g/rabbit)	38.27	38.27	38.27	38.32	38.20	38.27	0.08	NS
Final body weight (g/rabbit)	660.00a	652.50a	667.50a	655.00a	572.50b	626.25ab	22.20	*
Weight gain (g/rabbit/day)	22.19a	21.92a	22.46a	22.01a	19.07b	20.99a	0.79	*
Av.FI (g/rabbit/day)	46.29b	47.23ab	47.50ab	48.43ab	46.53ab	49.47a	0.94	*
Av. FCR	2.09c	2.17bc	2.13c	2.20bc	2.44a	2.36ab	0.72	*
PER	2.82a	2.80a	2.69ab	2.45ab	2.50ab	2.31b	0.13	*
EER	21.64a	21.38ab	21.90a	21.91a	19.02b	21.23ab	0.79	*
FC/kg	145.13	145.63	146.13	142.38	142.88	143.88	0.00	NS
FC/kgWG	303.30c	316.01bc	311.25bc	313.23bc	348.98a	338.73ab	10.44	*
TCP	548.13ab	552.61ab	554.37ab	553.09ab	543.18b	558.61a	3.58	*
REV	792.00a	783.00a	801.00a	786.00a	687.00b	751.50ab	26.64	*
Gross Margin	243.86a	230.38a	246.62a	232.90a	143.82b	192.89ab	25.51	*

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05); Av= average; FCR= feed conversion ratio; PER= protein efficiency ratio; EER= energy efficiency ratio; FC/kg= feed cost per kilogram; FC/kgWG= feed cost per kilogram weight gain; TCP= total cost of production; REV= revenue.

Table 5. Effect of shade dried *Tridax procumbens* on apparent nutrient digestibility of broiler starter

PARAMETERS	SDTP INCLUSION LEVELS (%)			
	0% SDTP	**5% SDTP**	**SEM**	**LOS**
Dry matter (%)	66.98	66.73	0.10	NS
Crude protein (%)	66.63	58.08	5.79	NS
Ether extract (%)	68.87	69.62	1.32	NS
Crude fibre (%)	59.32	60.44	1.27	NS
Ash (%)	63.51	62.94	2.89	NS
Nitrogen free extract (%)	68.74	69.79	1.02	NS

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05);

Table 6. Effect of enzyme supplementation on apparent nutrient digestibility of broiler starter

PARAMETERS	ENZYME SUPPLEMENTATION (PPM)				
	0ppm	**100ppm**	**200ppm**	**SEM**	**LOS**
Dry matter (%)	66.99a	67.41a	66.16b	0.12	*
Crude protein (%)	62.79	56.63	67.64	7.09	NS
Ether extract (%)	68.91	68.67	70.17	1.61	NS
Crude fibre (%)	61.20	58.13	60.32	1.56	NS
Ash (%)	65.28	61.33	63.07	3.55	NS
Nitrogen free extract (%)	68.43b	72.77a	66.60b	1.25	*

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05).

Table 7. Interactive effect of shade dried *Tridax procumbens* and enzyme supplementation on apparent nutrient digestibility of broiler starter

PARAMETERS	INTERACTION TREATMENT							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**	**LOS**
Dry matter (%)	67.36a	67.41a	66.16b	66.63b	67.41a	66.16b	0.17	*
Crude protein (%)	75.61	56.63	67.64	49.98	56.63	67.64	10.02	NS
Ether extract (%)	67.78	68.67	70.17	70.04	68.67	70.17	2.28	NS
Crude fibre (%)	59.52	58.13	60.32	62.88	58.13	60.32	2.20	NS
Ash (%)	66.14	61.33	63.07	64.42	61.33	63.07	5.02	NS
Nitrogen free extract (%)	66.86	72.77	66.60	70.01	72.77	66.60	1.76	NS

SEM= Standard error means, NS= No significant (P>0.05), LOS= Level of significant, a, b = Means on the same row bearing different superscript differ significantly (P<0.05).