MAXIGRAIN® ENZYME IMPROVES LAYING PERFORMANCE OF LAYER QUAILS (*CORTUNIX CORTUNIX JAPONICA*) FED SUGARCANE SCRAPPING MEAL-BASED DIETS

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Abstract

Three hundred and sixty 6 weeks old laying quails were utilized in an 8 week experiment to evaluate the effects of Maxigrain® enzyme supplementation of sugarcane scrapping meal-based diets on growth rate and laying parameters of layer Japanese quails (Coturnix coturnix japonica). Six diets tagged T10, $T10_{100}$, $T10_{200}$, T15, $T15_{100}$ and $T15_{200}$ were formulated to be isonitrogenous (20%CP) and isocaloric (2786.72 Kcal/kg ME). Diets T10 $T10_{100}$ and $T10_{200}$ contained 10% crude fibre while T15, $T15_{100}$ and $T10_{200}$ contained 15% crude fibre. The enzyme was include at 0,100 and 200ppm thus, treatments $T10_{100}$, $T10_{200}$, $T15_{100}$ and $T15_{200}$ contained 100 and 200pm of the enzyme such that T10 and T15 functioned as the control for $T10_{100}$ and $T10_{200}$, and $T15_{100}$ and $T15_{200}$ respectively. The birds were randomly allocated to the 6 dietary treatments at the rate of 60 birds per diet. Each treatment was replicated 4 times in a 3 x 2 factorial arrangement having 13 and 2 sexually mature female and male birds per replicate, respectively. The results showed that dietary fibre improved ($P<0.05$) dressing percentage (61.62 and 74.11%), white blood cells count (267.30 and 268.90 $x10^3$/ml) and neutrophils (1.83 and 2.00%) but reduced red blood cells count (3.39 and 3.34 $x10^6$/ml), lymphocytes (98.17 and 98.17%) and haemoglobin (14.12 and 13.93 g/dl). Birds fed the no-enzyme and 100 ppm enzyme supplemented diets produced better ($P<0.05$) white blood cells count (275.50 $x10^3$/ml). Lymphocytes (98.25%) and neutrophils (2.25%) were improved ($P<0.05$) in bird fed the no-enzyme and 200 ppm enzyme supplemented diets, and 100 ppm enzyme supplemented diets only. The interaction of enzyme and dietary fibre influenced ($P<0.05$) weight of heart as birds fed the T15 (0.54%), $T15_{100}$ (0.57%) and $T15_{200}$ (0.63%) had the heaviest weight while those fed the T15200 (10.06%) had the heaviest weight of gastrointestinal tract than those fed the other treated diets. In view of the comparable performances of the birds fed the high fibre-enzyme supplemented diets, farmers can use the combination for quail farming without affecting the meat quality and health of the birds.

***Keywords*: Layer quails, sugarcane scrapping meal, enzyme, growth rate, laying parameters.**

INTRODUCTION

The use of unconventional feedstuffs as substitutes for grains and other feedstuffs have been suggested thus, the search for non-conventional feedstuffs has been the most active area of animal nutrition research in the tropical world (Ikani and Adesehinwa, 2000). The search for cheaper sources of animal protein brings poultry birds into focus. Abdulmojeed *et al.* (2010) suggested that the quickest potential for bridging protein supply-demand gap lies in the production of highly prolific animals that are efficient converters of feed to flesh, have short generation interval such as poultry birds which includes quails and the integration of the wide array of cheap and locally available non-conventional feedstuffs at our disposal into well-defined feeding systems to reduce cost. One of such agro-industrial waste products is sugarcane scrapings.

According to Ayoade *et al.* (2007), sugarcane scrapping is obtained by scraping the outer part of the stem (rind) with a sharp knife to remove the bark on the stem that affords protection to the underlying cells. The scraping is done to remove the wax-covered epidermis and prepare the stem for chewing. The scrapings consist of the wax, pigments and fibrous materials of the rind, and a small quantity of the underline parenchyma cells. After scrapping, the material lies waste littering in both urban and rural settlements hereby constituting environmental pollution. It is heaped and burnt from time to time. Livestock such as cattle, goat and sheep scavenge these residues. Possible uses of the scrapings include feed for livestock and fuel for cooking. This could translate to substantial savings of money in this era of exorbitant prices of kerosene. The scrapping could also be used as mulching material for plants and when decayed could constitute a source of manure for the soil.

The proximate and energy composition of SCSM, according to the findings of Ayoade *et al.* (2007) indicates that the dry matter is about 87.6%, crude protein 3.2%, crude fibre 12.7%, Ether extract 2.8%, ash 12. 8%, NFE 77.1%, and gross energy of about 2.84 Mcal/kg. Augustine (2005) investigated the effect of replacement of maize with graded levels of sugarcane scraping meal (SCSM) on the performance and carcass characteristics of growing rabbits where SCSM replaced maize completely (100%) observed that the rabbits gained weight in all the treatments throughout the period of study while the digestibility of various nutrients and dressing percentages were high. These are indications of good nutritive value of SCSM in rabbit's rations. The author also reported that replacement of maize with SCSM reduced the production cost and could make rabbit available to the general public at lower cost. This is attributed to the fact that SCSM is very cheap compared to maize. Since body weight gain, and feed conversion ration were similar among treatments and there is reduction in production cost and profit increased as a result of the inclusion of SCSM, the author concluded that SCSM could replaced up to 100% of the maize in the diets of grower rabbits without adverse effect on performance.

Hastings (1946) and Allen *et al.* (1997) both observed that enzyme addition 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. Strategies for ensuring adequate nutrition of animals must be based on optimizing overall agricultural and livestock productivity from available resources, improving existing technologies and integrating technology that employs multipurpose crops and animals, and recycling of crop residues and by –products as feeding stuffs for animals (Njwe, 1990).

Maxigrain® enzyme is a multi-enzyme compound of β-glucanase, xylanase, phytase, arabinoxylanase and a mixture of yeast and minerals produced by the Bio-Organics Ltd. It is originates from the bacteria *Aspergillus oryzae.* Esuga *et al.* (2008) reported in an experiment to investigate the effects of feeding graded levels of palm kernel meal (PKM) in broiler chicken diets supplemented with Maxigrain® enzyme where PKM treated with Maxigrain® was included at 10, 20, 30, and 40% levels and observed a significant ($P<0.001$) difference in protein, fat, NFE and metabolizable energy retention in birds fed the control and Maxigrain® treated diets than those on diets without Maxigrain®.

The objective of this study is therefore, to evaluate the effect of replacing maize with sugarcane scraping meal supplemented with exogenous enzyme on layer growth rate and parameters of laying quails.

MATERIALS AND METHODS

Study area

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu – Lafia Campus. It is located in the Guinea Savanna zone of North Central Nigeria. It is located on latitude 08^0 35'N and longitude 08^0 33' E. The mean maximum and minimum temperatures are 35.06 and 20.16^0C, respectively while the mean relative humidity is 74 %. The annual rainfall is about 1168.90 mm (NIMET, 2008).

Sugarcane scrapping

Sugarcane scrapings was sourced from local sugarcane marketers within Lafia metropolis, sun-dried and milled to form the sugarcane scrapping meal (SCSM). The analyzed result is presented in Table 1.

Source of Maxigrain® enzyme

Maxigrain® enzyme a multi-enzyme compound of β-glucanase, xylanase, phytase, arabinoxylanase and a mixture of yeast and minerals was purchased from Animal Care, Abuja.

Description of experimental diets and experimental design

Six experimental diets T_{10}, T_{10}100, T_{10}200, T_{15}, T_{15}100 and T_{15}200 were compounded to be isonitrogenous (20% crude protein) and isocaloric (2650Kcal/Kg ME) with two levels of crude fibre. Three hundred and sixty 9-weeks old laying quails were randomly allocated to the treatments at rate of 60 birds per diet in an experiment that lasted for 8 weeks. Each treatment was replicated 4 times in a 3 x 2 factorial arrangement having 13 and 2 sexually mature female and male birds per replicate, respectively. Treatments T10, $T10_{100}$ and $T10_{200}$ contained 10% crude fibre (normal fibre level) while treatments T15, $T15_{100}$ and $T15_{200}$ contained 15% crude fibre level (high fibre level). The exogenous enzyme (Maxigrain®) was included at 0, 100 and 200ppm thus, treatments T10 and T15 contained 0ppm, $T10_{100}$ and $T15_{100}$ contained 100ppm while $T10_{200}$ and $T15_{200}$ contained 200ppm of the Maxigrain® enzyme supplementation such that treatment T10 and T15 served as the control for treatments $T10_{100}$ and $T10_{200}$ and $T15_{200}$ and $T15_{200}$ respectively. Other ingredients were included at the recommended levels to meet the nutrient requirements of the birds. The analyzed experimental diets for layer quails are presented in Table 2.

Data collection

Hen day egg production (HDEP)- this was measured as the total number of eggs laid per day divided by the number of hens in each pen house multiplied by 100. This was measured fortnightly:

$$\text{Hen day} = \frac{\text{Total number of eggs laid}}{\text{Number of hens}} \times 100$$

Feed conversion ratio- this was calculated as shown below:

$$\text{FCE} = \frac{\text{Feed intake (g)}}{\text{Weight of eggs produced (g)}}$$

External characteristics of eggs

Two eggs per replicate were sampled at random for four consecutive days, each egg was assessed separately for egg weight, egg circumference/diameter and shell thickness.

Individual egg weight was measured using a sensitive electronic balance. Egg width for each sampled egg was measured using a vernier caliper. The shells were dried and the shell thickness measured using a micrometer screw gauge as outlined by Odunsi *et al.* (2007).

Statistical analysis

Data obtained were subjected to one way analysis of variance (ANOVA). The separation of means was effected using least significant difference method and tested at probability level of 5% as described by Steel and Torrie (1980). The following statistical model was used:

$$Y_{ij}=\mu+A_i+B_j+(AB)_{ij}+€_{ijk}$$

Where $Y_{ij=}$ Individual observation

μ = general Mean

A_i =effect of Factor A

B_j =effect of Factor B

$(AB)_{ij}$=effect of interaction AB

$€_{ijk}$=experimental error

RESULTS AND DISCUSSION

Chemical composition of sugarcane scrapping

The chemical composition of the test ingredient (sugarcane scrapping) as presented in Table 1 shows that the calculated metabolizable energy from the proximate composition data using the formula described (Pauzenga, 1985) ME (kcal/kg) = 37x % cp x 81.1 x % EE + 35.5 x % NFE was about 2970.45. The test ingredient contain low (8.25%) crude protein, high crude fibre and low (3.36%) either extract. The dry matter was about 90.67% while ash and nitrogen free extract were about 9.98 and 67.40%, respectively. This composition suggests that sugarcane scrapping, being a fibrous feed material, will require some level of processing or pre-digestion if must be fed to monogastric animals. The levels of these minerals were adequate for quails in this age group (Musa *et al.*, 2007). The fibre fraction, NDF (neutral detergent fibre), ADF (acid detergent fibre), ADL (acid detergent lignin), hemicelluloses and cellulose were within the range of 39.96 - 56.38%, 19.21 - 38.21%, 5.92 - 6.37%, 18.17 - 24.90% and 13.12 - 25.84% respectively.

Analyzed and energy composition of experimental diets

The chemical composition of the experimental diets for layer quail is presented in Table 2. The diets were formulated such that they were isonitrogenous (about 19.00%CP). The calculated metabolizable energy from the proximate composition data of the diets using the formula as described by Pauzenga (1985) ME (kcal/kg) = 37 x % CP + 81.1 x % EE + 35.5 x % NFE, was isocaloric (2900 kcal/kg ME) and it is adequate for layer quails (Musa *et al.*, 2007 and Bawa *et al.*, 2012). The crude fibre values were about 10% for diets T10, $T10_{100}$ and T_{200} which diets T15, $T15_{100}$ and $T15_{200}$ was about 15%. The crude fibre level increased with increasing level of sugarcane scrapping meal in the diets. The values obtained for ether extract were less than 4% ranging from 3.68-3.91% Ash value was between 5.26-5.73% the NFE was within the range of 59.07-61.32% fibre traction NDF, ADF, ADL hemicellulose and cellulose were within the range of 49.65-55. 69%. 27.29-33.96%, 10.67-17.15%, 20.80-23.36% and 16.62-18.59% respectively calcium and phosphorus of the diets were calculated from NRC (1979) and were within the range of 2.99-3.14% and 1.61-1.71%, respectively. The levels of these minerals were adequate for layer quails in this age group (Musa *et al.*, 2007).

Effect of Maxigrain® enzyme supplementation or dietary fibre on growth performance and layer parameters of laying quails

Table 3 summarizes the effect of Maxigrain® enzyme supplementation or dietary fibre on growth performance and layer parameters of laying quails. Enzyme supplementation did not improve feed intake, daily weight gain and feed efficiency of layer quails consequent, efficiency of feed consumed reduced significantly with increase in enzyme supplemented diets. Other parameters such as hen day production egg production per day, hatchability, age at first egg, total number of eggs laid, egg weight and egg height were not influenced by the inclusion of enzyme in the diets. The result of these findings differ from the earlier reports of Ademola *et al*. (2011) who investigated the effect of Maxigrain® enzyme supplementation to rice bran and palm kernel meal diets on performance and cost implication of laying hens and observed significant variation in the feed conversion efficiency and profit. Sekoni *et al*. (2008) earlier reported that Maxigrain® treated palm kernel meal increased retentions of vital nutrients and metabolizable energy of broiler chickens. It is therefore, thought that Maxigrain® must have acted on cellulose glucoronoxylans and arabinoxylans of the test ingredient thereby reducing the crude fibre and increasing the metabolizable energy which translated into uniform parameter for the enzyme high fibre diet groups.

Dietary fibre improved significantly final live weight, daily feed intake, daily weight gain, feed efficiency and age at first egg but reduced significantly hen day production, egg production per day and cost of feed consumed per egg. There was no variation in hatchability, egg weight per egg and egg production due to dietary fibre. These observations may be explained by the fact that the excess energy derived by birds placed on high fibre diet may have resulted from the fact that the hens ate more to compensates for the low energy density associated with high fibre diets thus translating to more energy intake over a shorter period of time compared to those hens placed on the low fibre diets again. The nutrients derived from diets are what determine weights gain when absorbed and deposited. Generally, the values obtained in this study are similar to the 7.00-8.80g/egg for egg weight and 163.00 - 184.33 g/bird for final weight as reported by Edache *et al*. (2003a; 2010); higher values were recorded of 56.25 – 77.20% for hen day production and similar values of 2.24 - 2.62 N/egg, as reported (Tuleun and Dashe, 2010; Babangida and Ubosi, 2004) and 58.15% of hatchability (Abatcha *et al*., 2010).

Effects of Maxigrain® enzyme supplementation and dietary fibre on growth performance, layer parameters and economics of production of laying quails

The interaction of dietary fibre and Maxigrain® enzyme supplementation did not influence the laying performance parameters of layers except for feed efficiency which was significantly improved at high fibre level with or without enzyme supplementation. Japanese quails mature in about six weeks (Randal, 1998; Edache *et al.*, 2003b; Bakare and Odunsi, 2008) and reach their peak egg production by 50 days of age, these reports tallies with the results of this study as age at first egg was between 35.25 - 37.50 days. Since there was no variation in the final weight, egg weight was not expected to vary because egg weight at all stages of the laying years is significantly correlated with age and body weight at first egg (Lewis *et al*., 1998; Babangida *et al.*, 2000). The result was consistent with the earlier work of Ayasan *et al*. (2006) who evaluated the effects of dietary inclusion of probiotics protexin on egg yield parameters of Japanese quails and observed that supplementation of protein to the diets had not significant effects on feed efficiency, feed intake, average egg weight, egg shall thickness and egg shape index. Similarly, there was no variation (P>0.05) in the economics of production due to the interactive effects of fibre and enzyme supplementation.

Conclusion and Recommendation

The findings of this study revealed that the nutritional evaluation of sugarcane scrappings shows that the high energy content (about 2970.45 Kcal/kg ME) of the test ingredient supports growth and meat production in the diets of laying quails. Nutrient digestibility was influenced by both the enzyme, fibre and the interactive effect of the two. Similarly, Most of the haematological, serum biochemical parameters evaluated were affected by the enzyme supplemented, dietary fibre but the interaction of the enzyme supplementation and dietary fibre did not have any effect. Some of the visceral organs were influenced by the interactive effects of enzyme and fibre; some of the visceral organs were influenced by the interactive effects of enzyme and fibre. In view of the outstanding performance of the quails fed the high fibre-high enzyme supplemented diets, it is necessary that a further work in terms of processing of sugarcane scrapings be carried out to identify the factor(s) that militated against egg production in spite of the supplementation of exogenous enzyme in the diets. The finding will help guide the intending farmer on the choice to make on method of processing and level of inclusion.

Table 1: Proximate and energy composition of sugarcane scrapping

Nutrient	CP	EE	CF	Ash	DM	NFE	[a]Energy (Kcal/kgME)
%	8.25	3.36	36.48	9.98	90.67	67.40	2970.45

[a]Calculated from Pauzenga (1985)

Table 2. Proximate and chemical composition of layer quails diets (%)

Nutrients	**T10**	**$T10_{100}$**	**$T10_{200}$**	**T15**	**$T15_{100}$**	**$T15_{200}$**
Dry matter	89.65	89.79	89.96	89.71	89.71	89.87
Crude protein	19.68	19.37	19.49	20.13	20.58	20.29
Crude fibre	10.75	10.26	10.19	10.84	10.96	10.70
Ether extract	3.86	3.79	3.68	3.91	3.83	3.89
Ash	5.67	5.26	5.43	5.73	5.56	5.47
Nitrogen-free extract	60.04	61.32	61.21	59.39	59.07	59.56
Neutral detergent fibre	49.65	51.06	55.69	52.69	54.12	53.86
Acid detergent fibre	27.29	29.87	33.96	31.89	32.67	31.95
Acid detergent lignin	10.67	11.28	17.15	13.38	15.86	14.79
Hemicellulose	23.36	21.19	21.73	20.80	21.45	21.91
Cellulose	16.62	18.59	16.81	18.51	16.81	17.16
[a]Calcium	3.14	3.14	3.14	2.99	2.99	2.99
[a]Phosphorus	1.71	1.71	1.71	1.61	1.61	1.61
[b]Energy (Kcal/kg ME)	2972.63	2900.92	2992.53	2970.26	2969.06	2978.46

[a]calculated from NRC (1979) [3], [b]calculated from Pauzenga (1985) [18].

Table 3: Effect of Maxigrain® enzyme supplementation or dietary fibre on growth performance, layer parameters and economics of producing of laying quails

Performance indices	ENZYME TREATMENT MEANS					FIBRE TREATMENT MEANS			
	No Enzyme	**100ppm Enzyme**	**200ppm Enzyme**	**SEM**	**LOS**	**Low Fibre**	**High fibre**	**SEM**	**LOS**
Live weight (g/bird)	161.20	160.00	147.50	3.57	NS	156.70	155.80	2.91	NS
Final weight (g/bird)	183.00	190.50	185.10	2.08	NS	183.30 [b]	189.10 [a]	1.70	*
Daily feed intake (g/bird/day)	41.89[a]	39.81 [b]	40.06	0.34	*	38.22 [b]	42.96 [a]	0.28	*
Daily weight gain (g/bird/day	3.49 [a]	3.36 [b]	3.34	0.10	*	1.07 [b]	1.33 [a]	0.08	*
Feed efficiency	3.49 [a]	3.36 [b]	3.34 [b]	0.03	*	3.21 [b]	3.58 [a]	0.02	*
Hen day production	39.50	39.90	38.40	2.28	NS	56.60 [a]	22.00 [b]	2.31	*
Egg production/day	3.55	3.59	3.46	0.25	NS	5.10 [a]	1.98 [b]	0.21	*
Hatchability (%)	56.70	57.50	60.80	3.63	NS	62.80	53.90	2.96	NS
Age @ first egg	36.50	36.25	36.62	0.18	NS	35.58 [b]	37.33 [a]	0.15	*
Total eggs laid/bird	88.90	89.90	86.50	6.35	NS	127.40 [a]	49.40 [b]	5.19	*
Egg weight (g/egg)	7.67	7.70	8.23	0.26	NS	8.11	7.62	0.22	NS
Egg height (mm)	8.50	8.62	9.12	0.54	NS	9.42	8.08	0.44	NS
Feed cost /kg (₦/kg)	72.51	72.68	72.86	-	-	79.60	65.41	-	-
Cost of feed consumed /egg (₦/egg)	3.02[a]	2.88 [b]	2.90 [b]	0.02	*	3.04 [a]	2.81 [b]	0.02	*

a, b- Means on the same row bearing different superscript differ significantly (P < 0.05), **NS**- No significant difference (P > 0.05)
LOS- Level of significant difference.

Table 4. Effects of Maxigrain® enzyme supplementation and dietary fibre on growth performance, layer parameters and economics of production of laying quails

Performance indices	MAIN TREATMENT MEANS							
	T10	**$T10_{100}$**	**$T10_{200}$**	**T15**	**$T15_{100}$**	**$T15_{200}$**	**SEM**	**LOS**
Live weight (g/bird)	165.00	157.50	147.50	157.50	162.50	147.50	5.05	NS
Final weight (g/bird)	181.80	185.80	182.50	184.20	193.20	187.80	2.94	NS
Daily feed intake (g/bird/day)	39.34	37.88	37.43	44.43	41.74	42.70	0.49	NS
Daily weight gain (g/bird/day	0.68	1.13	1.40	1.07	1.31	1.61	0.14	NS
Feed efficiency	3.28^{b}	3.25^{b}	3.12^{b}	3.70^{a}	3.48^{ab}	3.56^{a}	0.04	*
Hen day production	60.30	56.70	52.90	18.70	23.20	24.00	3.99	NS
Egg production/day	5.43	5.10	4.76	1.68	2.09	2.16	0.36	NS
Hatchability (%)	65.00	58.30	65.00	48.30	56.70	56.70	5.13	NS
Age @ first egg	35.75	35.25	35.75	37.25	37.25	37.50	0.26	NS
Total eggs laid/bird	135.80	127.50	119.00	42.00	52.30	54.00	8.99	NS
Egg weight (g/egg)	7.79	7.56	8.99	7.56	7.84	7.48	0.37	NS
Egg height (mm)	9.75	8.75	9.75	7.25	8.50	8.50	0.77	NS
Feed cost /kg (₦/kg)	79.60	79.77	79.95	65.41	65.58	65.76	**-**	**-**
Cost of feed consumed /egg (₦/egg)	3.13	3.02	2.99	2.90	2.73	2.81	0.03	NS

a,b- Means on the same row bearing different superscript differ significantly ($P < 0.05$), **NS-** No significant difference ($P > 0.05$), **LOS-** Level of significant difference

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