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Meat Quality of Female Quails (*Cortunix cortunix japonica*) Fed Low or High Fibre Diets Supplemented with Maxigrain® Enzyme

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Abstract: Four hundred 3 weeks old finisher Japanese quails (*Cortunix cortunix japonica*) were used to investigate the effect Maxigrain® enzyme supplementation on dressing percentage, carcass cut and percent organ weights fed sugarcane scrapping meal-based diets. The birds were randomly allotted to 6 experimental diets tagged T_{10}, $T_{10}100$, $T_{10}200$, T_{15}, $T_{15}100$ and $T_{15}200$ which were compounded to be isonitrogenous (23% crude protein) and isocaloric (2900Kcal/Kg ME). Treatments T_{10}, $T_{10}100$ and $T_{10}200$ contained 10% crude fibre (low fibre level) while treatments T_{15}, $T_{15}100$ and $T_{15}200$ contained 15% crude fibre level (high fibre level). The enzyme was included at 0, 100 and 200ppm thus, treatments T10 and T_{15} contained 0ppm, $T_{10}100$ and $T_{15}100$ contained 100ppm and $T_{10}200$ and $T_{15}200$ contained 200ppm of the enzyme such that treatments T_{10} and T_{15} served as the control for treatments $T_{10}100$ and $T_{10}200$ and $T_{15}100$ and $T_{15}200$ for low and high fibre diets, respectively. The birds were randomly allocated to the treatments at the rate of 80 birds per diet; each treatment was replicated 4 times in a 3×2 factorial arrangement. At the end of the 3 weeks feeding trial, 10 female birds per treatment were randomly selected according to average group weight, slaughtered and their carcasses evaluated. All the parameters evaluated were not at variance ($P>0.05$) across the dietary treatment groups except for back (22.52 vs. 24.32 and 21.62%), neck (7.78 vs. 10.24 and 7.49%) and gastrointestinal tract (8.44 vs. 10.84 and 12.22%) which was significantly ($P<0.05$) heavier in percent weight due to enzyme supplementation. Raising dietary fibre from low to high level significantly ($P<0.05$) reduced the percent weight of fasted weight (144.20 and 124.70 g/bird), dressed weight (87.52 and 83.79 g/bird), back (24.80 and 20.84%), neck (9.41 and 7.59%) and liver (3.06 and 2.92%) but increased that of legs (2.54 and 2.92%) and heart (0.69 and 0.82%) while the interactive effects of enzyme and dietary fibre affected the percent weights of legs, drumstick, back, neck, heart and liver. From the findings of this study, sugarcane scrapping can replace conventional energy sources to a level that is economically beneficial and nutritionally safe in quail production if arabinoxylanase is supplemented at 100ppm.

Key words: Maxigrain®, female finisher quails, sugarcane scrapping meal, carcass characteristics and fibre

INTRODUCTION

Farm animals constitute a very important source of animal protein which arises from meat milk and eggs for human beings. These foods are rich sources of amino acids, minerals and vitamins useful for a healthy human existence but inadequate supply for human needs underscores the need to increase the production of these farm animal products. The high costs of meat and meat products tend to make the matter worse. High increases in costs of animal products are mainly due to high cost of raw materials for the feed industry especially maize. The high cost of maize is compounded by its low production and high demand for human food, industrial use and animal feeds, thus the need for alternative sources of energy. Sugarcane scrappings poses some nutrients. The findings of Ayoade *et al.* (2007) indicate that its dry matter is about 87.6%, with low crude protein of 3.2%. The crude fibre is about 12.7% while the gross energy was about 2.84 Mcal/kg; this suggests that it can be a good source of energy for animals. 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

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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.

There is evidence that pre-digestion or any attempt to initiate the hydrolysis of feed components often enhances the digestibility and utilization when fed in animal diets. One of such techniques is the use of exogenous treatment of feedstuff with enzyme preparations (Bio-Ingredients Ltd, 2004). Although the use of commercial feed enzymes has gained world-wide acceptability, its use in Nigeria is still not popular. The uses of exogenous enzymes are known to help in the digestibility of feed ingredients and allow for the use of cheaper, poorer quality materials to obtain optimum performance. Maxigrain® enzyme is a multi-enzyme compound of beta-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*. The objective of this study is therefore; to evaluate the effect of replacing maize with sugarcane scraping meal supplemented with exogenous enzyme on carcass quality of mature female 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°35'N and longitude 08°33' E. The mean maximum and minimum temperatures are 35. 06 and 20.16°C respectively while the mean relative humidity is 74%. The annual rainfall is about 1168. 90mm (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).

Biochemical analysis: The proximate analysis of sugarcane scrapings and experimental diets were done at the International Institute for Tropical Agriculture (IITA) Ibadan, using the procedure outlined by AOAC (1990) while the fibre fractions namely Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined by methods of Vansoest and Robertson (1985) and the values reported on dry matter basis.

Description and preparation of diets for finishing quails: Six experimental diets tagged T_{10}, $T_{10}100$, $T_{10}200$, T_{15}, $T_{15}100$ and $T_{15}200$ were compounded to be isonitrogenous (23% crude protein) and isocaloric (2900Kcal/Kg ME) with two levels of crude fibre. The birds were randomly allocated to the treatments at rate of 80 birds per diet in a 3 week experiment; each treatment was replicated 4 times in a 3×2 factorial arrangement. Treatments T_{10}, $T_{10}100$ and $T_{10}200$ contained 10% crude fibre while treatments T_{15}, $T_{15}100$ and $T_{15}200$ contained 15% crude fibre level (high fibre level). The exogenous enzyme was included at 0, 100 and 200ppm thus, treatments T_{10} and T_{15} contained 0ppm, $T_{10}100$ and $T_{15}100$ contained 100ppm and $T_{10}200$ and $T_{15}200$ contained 200ppm of the enzyme supplementation such that treatments T_{10} and T_{15} served as the control for treatments $T_{10}100$ and $T_{10}200$ and $T_{15}100$ and $T_{15}200$ for low and high fibre diets, respectively.

Management of experimental birds: The birds were fed *ad-libitum* and had access to drinking water at all times. Lighting source was provided using electricity bulbs during the night. The birds were administered anti-stress vitamin/mineral premix orally at the recommended dosage after the randomization before the commencement of the experiment. The birds were housed in a deep litter pens constructed using wire mesh to allow for adequate ventilation. Other routine management practices were adopted as outlined by Musa *et al.* (2008).

Data collection

Slaughtering procedure: At 14 weeks of age, carcass data were collected from 10 randomly selected birds per treatment group. The birds were fasted for 12h (but had access to water only) and individually weighed using a 5-kg scale with a precision of 0.005. The birds were starved to determine the actual live weight of the birds and reduce gut content thus, reducing the risk of contamination of the carcass during dressing without affecting meat quality. They were then slaughtered by severing the carotid arteries and jugular veins and blood drained under gravity; the carcasses were then divided into the following parts as described by Kleczek *et al.* (2007).

Head : The head was obtained by cutting off between the occipital condyl and the atlas

Neck : This was obtained by cutting along the line joining the cephalic borders of the coracoids

Wing : The wing was obtained by cutting through the shoulder joint

Thigh : This was obtained by cutting through the hip joint (from the pubic process, through the groin towards the back and the along the backbone, starting from the anterior border of the pelvis)

Breast : It was obtained by a double cut through the cartilaginous junctures of the ribs, from the anterior border of the backbone towards the coracoids

Back : This is referred to as the dorsal-lumbar quarter (the remaining part of the carcass)

The relative fasted body weight (% of final live body weight) was obtained. The weight of the thigh, breast and back were taken as the carcass weight, was later expressed as percentage of the final live body weight. Similarly, the relative weights of the cut parts (head, neck, wing, thigh, breast and back) and the visceral organs (liver, heart and small and large intestines) were determined using the formula (Mohammed *et al*., 2008):

$$\text{Relative Weight (cut part or organ)} = \frac{\text{Fresh weight of cut part or organ}}{\text{Final live body weight of bird}} \times 100$$

Statistical analysis: Data obtained were subjected to Two Way Analysis of Variance (ANOVA) and where significant differences (P>0.05) are observed, means were separated using Duncan's Multiple Range Test (Duncan, 1955) as described by Steel and Torrie (1980). The following statistical model was used: $Y_{ij}=\mu+A_i+B_j+(AB)_{ij}+\epsilon_{ijk}$, where, Y_{ij} = Individual observation, μ = general Mean, A_i = effect of Factor A, B_j = effect of Factor $(AB)_{ij}$ = effect of interaction AB and ϵ_{ijk} = experimental error.

RESULTS AND DISCUSSION

Chemical composition of sugarcane scrapping: The chemical composition of the test ingredient (sugarcane scrapping) is presented in Table 1. The calculated metabolizable energy from the proximate composition data using the formula described (Pauzenga, 1985) ME (kcal/kg) = 37×% cp×81.1×% EE+35.5 ×% 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 it must be fed to monogastric animals.

The levels of these minerals were adequate for quails in this age group and status (Musa *et al*., 2008). 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 finisher quail diets is presented in Table 2. The 6 diets were formulated to be isonitrogenous (about 22% CP) while the calculated metabolizable energy from t he proximate composition data of the diets using the formula as described by Pauzenga (1985): ME (kcal/kg) = 37×% Cp+81.1×% EE+35.5×% NFE, was isocaloric (about 2800 kcal/kg ME) and it is adequate for quails within this age group (Farrel *et al*., 1973 and Bawa, 2012c). The crude fibre values were about 10% for diets T10, $T10_{100}$ and $T10_{200}$ and about 15% for diets T15 $T15_{100}$ and $T15_{200}$. The crude fibre level increased as the level of sugarcane scrapping meal increased in the diets. The values for ether extract were less than 5% and were within the range of 2.76-4.27% as recommended by Musa *et al*. (2008). The

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 finisher quail diets (%)

Nutrients	T10	$T10_{100}$	$T10_{200}$	T15	$T15_{100}$	$T15_{200}$
Dry matter	89.26	89.28	89.71	89.14	89.95	89.03
Crude protein	22.58	22.70	23.30	23.09	23.40	23.04
Crude fibre	10.21	10.16	10.13	15.27	15.78	15.38
Ether extract	4.26	4.06	3.76	3.71	4.27	2.76
Ash	7.42	6.79	6.69	6.91	6.63	7.78
Nitrogen-free extract	55.53	66.45	56.12	51.02	49.92	51.04
Neutral detergent fibre	47.18	59.38	57.35	63.59	55.18	61.43
Acid detergent fibre	36.24	37.68	36.79	42.86	36.43	40.26
Acid detergent lignin	11.87	12.59	13.09	12.79	12.21	14.37
Hemicellulose	10.94	21.70	20.56	20.73	18.75	21.17
Cellulose	24.37	25.09	23.70	30.07	24.22	25.89
[a]Calcium	0.89	0.89	0.89	0.84	0.84	0.84
[a]Phosphorus	0.73	0.73	0.73	0.71	0.71	0.71
[b]Energy (kcal/kg ME)	2852.26	2873.14	28159.30	2866.42	2884.26	2888.24

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

Table 3: Effect of Maxigrain® enzyme supplementation or dietary fibre on carcass characteristics of female quails

	Enzyme treatment means					Fibre treatment means			
Parameters	No enzyme	100ppm enzyme	200ppm enzyme	SEM	LOS	Low fibre	High fibre	SEM	LOS
Cut parts									
Fasted weight (g/bird)	135.80	132.90	134.60	3.62	NS	144.20[a]	124.70[b]	2.95	*
Dressed weight (g/bird)	85.78	85.11	86.07	0.93	NS	87.52[a]	83.79[b]	0.76	*
Dressing percentage (%)	63.60	64.70	64.60	2.09	NS	60.80	67.80	1.71	NS
Head (%)	6.03	5.86	5.81	0.12	NS	5.79	6.01	0.12	NS
Legs (%)	2.76	2.70	2.81	0.08	NS	2.54[b]	2.92[a]	0.07	*
Wings (%)	10.72	11.12	10.66	0.23	NS	10.44	11.23	0.19	NS
Drumstick (%)	22.54	22.84	22.74	0.34	NS	22.31	23.10	0.28	NS
Breast plate (%)	35.30	32.82	34.20	0.77	NS	34.16	34.06	0.63	NS
Back (%)	22.52[b]	24.32[a]	21.62[b]	0.50	*	24.80[a]	20.84[b]	0.50	*
Neck (%)	7.78[b]	10.24[a]	7.49[b]	0.51	*	9.41[a]	7.59[b]	0.42	*
Visceral organs									
Heart (%)	0.75	0.74	0.78	0.05	NS	0.69[b]	0.82[a]	0.03	*
Gastrointestinal tract (%)	8.44[b]	10.84[a]	12.22[a]	0.72	*	10.61	10.39	0.59	NS
Liver (%)	2.71	2.46	2.72	0.18	NS	3.06[a]	2.20[b]	0.10	*
Gizzard (%)	7.21	6.31	6.80	0.23	NS	6.94	6.61	0.23	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

ash content was within the range of 6.63-7.78% and that of NFE was about 49.92-66.45%.

The fibre fractions (NDF, ADF, ADL hemicelluloses and cellulose were within the range of 47.18-63.59%, 36.24-42.86%, 11.87-14.37%, 10.94-21.17% and 24.37-30.07%, respectively. Similarly, the mineral composition (calcium and phosphorus) were within the range of 0.84-0.89% and 0.71-0.73 for calcium and phosphorus, respectively. These values are adequate for finisher quails (Musa *et al*., 2008).

Carcass characteristics: Shown in Table 3 is the summary of the effect of Maxigrain® enzyme supplementation or dietary fibre on the carcass characteristics of female quails. All the parameters evaluated were not at variance (P>0.05) across the dietary treatment groups except for back (22.52 vs. 24.32 and 21.62%), neck (7.78 vs. 10.24 and 7.49%) and gastrointestinal tract (8.44 vs. 10.84 and 12.22%) which was significantly (P<0.05) heavier in percent weight due to enzyme supplementation. The improvements in the parameters in the present study conform to the earlier assertion (Adeola and Olukosi, 2008) that enzyme supplementation improves performance of animals. The break down of fibrous material by the enzyme enables the birds acquires more nutrients from the feed thus depositing them as tissues in the body. These observations were consistent with the previous report of Esuga *et al*. (2008) who observed a non-significant variation in percent thigh when they supplemented Maxigrain® enzyme in the diets of broiler chickens. The findings of this study confirm the earlier report of Esuga *et al*. (2008). The values recorded in this findings were close to the 83.15-113.35 g, 68.59-71.72%, 7.85-9.10% for dressed weight, dressing percentage and wings as reported by Tuleun *et al*. (2009), respectively but lower values of 12.40-15.80% were recorded for thigh by Tuleun *et al*. (2009).

Raising dietary fibre from low to high level significantly (P<0.05) reduced the percent weight of fasted weight (144.20 and 124.70 g/bird), dressed weight (87.52 and 83.79 g/bird), back (24.80 and 20.84%), neck (9.41 and 7.59%) and liver (3.06 and 2.92%) but increased that of legs (2.54 and 2.92%) and heart (0.69 and 0.82%). The results of this study disagree with the earlier reports (Bello *et al*., 2007 and Ayoade *et al*., 2007). Ayoade *et al*. (2007) reported non-significant variation of the dressing percentage across the dietary treatment group in rabbits fed sugarcane scrapping meals.

The result of the interaction of enzyme and dietary fibre is summarized in Table 4. The result showed that enzyme and dietary fibre affected the percent weights of legs, drumstick, back, neck, heart and liver. These observations are consistent with the findings earlier reported (Bawa *et al*., 2010; Mcdonald *et al*., 1995; Aduku, 2004 and Atteh, 2002). The non-significant variations observed are in consonance with the earlier report (Alu *et al*., 2010) that Nutrase Xyla® enzyme supplementation had no significant effect on carcass characteristics of grower pigs. On the other hand, the results did not agree with the earlier findings of Fombad and Maffeja (1980) who reported a significant decline in the values of empty carcass weight as the level of fibre increased in the diets with or without enzyme supplementation. The values recorded in this study were close to those reported by Tuluen *et al*. (2009).

Similarly, Maxigrain® supplementation on brewers dried grain and maize offal-based diets for broilers chickens showed significant variations in the percent weights for breast plate, drumstick, necks, head, wings and major

Table 4: Effect of Maxigrain® enzyme supplementation and dietary fibre on carcass characteristics of female quails

	MAIN TREATMENT MEANS							
Parameters	T10	$T10_{100}$	$T10_{200}$	T15	$T15_{100}$	$T15_{200}$	SEM	LOS
Cut parts								
Fasted weight (g/bird)	145.00	143.30	144.00	126.70	122.50	125.00	5.11	NS
Dressed weight (g/bird)	85.45	87.19	89.91	86.10	83.03	82.24	1.32	NS
Dressing percentage (%)	59.00	61.00	62.40	68.30	68.40	66.80	2.96	NS
Head (%)	6.11	5.67	5.60	5.96	6.06	6.02	0.16	NS
Legs (%)	2.63^{b}	2.62^{b}	2.38^{b}	2.76^{b}	2.77^{b}	3.25^{a}	0.11	*
Wings (%)	10.05	11.04	10.21	11.39	11.19	11.11	0.33	NS
Drumstick (%)	23.30^{a}	22.11^{b}	21.52^{b}	21.78^{b}	23.57^{a}	23.95^{a}	0.48	*
Breast plate (%)	35.20	32.79	34.48	35.40	32.85	33.93	1.10	NS
Back (%)	24.31^{a}	24.75^{a}	25.33^{a}	20.72^{b}	23.90^{ab}	17.90^{c}	0.70	*
Neck (%)	7.66^{b}	12.45^{a}	8.12^{b}	7.90^{b}	8.02^{b}	6.87^{c}	0.73	*
Visceral organs								
Heart (%)	0.76^{b}	0.60^{b}	0.71^{b}	0.73^{ab}	0.88^{a}	0.85^{a}	0.03	*
Gastrointestinal tract (%)	8.88	12.18	10.75	8.00	9.50	13.68	1.02	NS
Liver (%)	2.89^{a}	3.20^{a}	3.09^{a}	2.53^{b}	1.71^{b}	2.35^{b}	0.18	*
Gizzard (%)	7.05	6.50	7.26	7.36	6.13	6.34	0.39	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

organs (Bawa *et al*., 2010). The significant variation of pre-slaughter weight, carcass weights and dressing percentages due to brewers dried grain or maize offal diets supplemented with Maxigrain® as reported by same authors are at variance with the results of this study. Of all the visceral organs evaluated enzyme supplementation increased significantly heart, liver and gizzards. The values of the vital organs expressed as percentage of the live weights were however within the normal ranges reported for female quails (Woodard *et al*., 1973), suggesting the absence of toxic effects of the diets.

Conclusions and recommendations: The findings of this study revealed that the nutritional evaluation of sugarcane scrappings is high in energy content (about 2970.45 Kcal/kg ME) and supports growth and meat yield of finishing quails. Carcass parameters were influenced by enzyme, fibre and the interactive effect of enzyme and fibre.

In view of the performance of the quails fed the high fibre-high enzyme supplemented diets, quail farmers can use 200 ppm Maxigrain® enzyme supplementation in fibrous based diets including sugarcane scrapping meal without affecting the meat quality of the birds.

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