

## Response Of Finisher Japanese Quails (*Cortunix Cortunix Japonica*) To Enzyme-Supplemented Sugarcane Scrapping Meal-Based Diets And Cost Implication

\*S. E. Alu<sup>1</sup>, F. G. Kaankuka<sup>2</sup>, S. N. Carew<sup>3</sup> And C. D. Tuleun<sup>2</sup>

<sup>1</sup>Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, P.M.B.135, Shabu-Lafia Campus, Nasarawa State, Nigeria.

<sup>2</sup>Department of Animal Nutrition, <sup>3</sup>Department of Animal Production, College of Animal Science, University of Agriculture, P.M.B. 2373 Makurdi, Benue State, Nigeria.

\*Corresponding Author: Tel. +2348033690937 & +2348091651998

### ABSTRACT

The study investigated the response of finisher Japanese quails (*Cortunix cortunix japonica*) to enzyme-supplemented sugarcane scrapping meal-based diets and cost implication using 400 three weeks-old Japanese quails in a 3 week experiment. The birds were randomly allocated to 6 experimental diets tagged T<sub>10</sub>, T<sub>10</sub>100, T<sub>10</sub>200, T<sub>15</sub>, T<sub>15</sub>100 and T<sub>15</sub>200 which were compounded to be isonitrogenous (23% crude protein) and isocaloric (2900Kcal/Kg ME). Treatments T<sub>10</sub>, T<sub>10</sub>100, and T<sub>10</sub>200 contained 10% crude fibre (normal fibre level) while treatments T<sub>15</sub>, T<sub>15</sub>100 and T<sub>15</sub>200 contained 15% crude fibre level (high fibre level). The exogenous enzyme was included at 0, 100 and 200ppm thus, treatments T<sub>10</sub> and T<sub>15</sub> contained 0ppm, T<sub>10</sub>100 and T<sub>15</sub>100 contained 100ppm and T<sub>10</sub>200 and T<sub>15</sub>200 contained 200ppm of the enzyme supplementation such that treatments T<sub>10</sub> and T<sub>15</sub> served as the control for treatments T<sub>10</sub>100, and T<sub>10</sub>200 and T<sub>15</sub>100 and T<sub>15</sub>200 for low and high fibre diets respectively. The birds were randomly allocated to the six dietary treatments at rate of 80 birds per diet in a 3 week experiment. Each treatment was replicated 4 times in a 3x2 factorial arrangement having 20 birds per replicate. The growth response parameters taken included body weight, feed consumption, weight gain, feed conversion ratio and protein efficiency ratio (PER) while the prevailing market prices of feeding stuffs were used to compute the cost benefit analysis. There was no significant variation in the growth parameters due to enzyme supplementation on growth rate and cost benefit except for water intake (126.20 vs. 142.10 and 106.26 ml/day), dietary fibre reduced final live weight, daily weight gain, protein efficiency ratio, FCR, water intake and cost benefit parameters but improved daily feed intake (21.93 and 27.94g/bird/day). The interactive effects of dietary fibre and enzyme supplementation did not influence growth rate and cost benefit parameters. From the conditions 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.

**Keywords:** Maxigrain<sup>(R)</sup>, Japanese finisher quails, growth rate, sugarcane scrapping meal, cost benefit and dietary fibre

### INTRODUCTION

The shortage and high price of animal protein have been aggravated by the high cost of conventional feed ingredients. The current high cost of commercial feeds is well known and reported by Oruseibio and Omu (2000), Alokun (2000), Ikani and Adesehinwa (2000), Babatunde *et al.* (2000) and Iyeghe-Erakpotobo and Muhammad (2004). Adegbola (1989) reported that feed accounts for 60-80% of production cost of monogastric animals in developing

countries compared to about 50-65% in developed countries. The low level of cereal and oil seed production and processing, the ravages of drought and the competition from direct human consumption have all contributed to the high cost of feed, which in turn has led to folding up of many poultry farms, especially small to medium-scale farms, and general decline in livestock production.

Nutritionists have the long-term challenge for research into least cost rations in order to sustain the farmers in production (Orusebio and Omu, 2000). These workers have reported that the challenge is ever-increasing due to the current economic problems in Nigeria. The scenario pointed out above has therefore forced animal nutritionists to expand the raw material base for livestock feed formulation to include an ever-increasing range of agro-industrial by-products and other unconventional feed resources. The incorporation of agro-industrial by-products into animal feeds holds tremendous potentials for alleviating the short supply and high cost of feed (Babatunde *et al.*, 2000). 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). Many of these agro- industrial by-products are fibrous in nature and their use in monogastric farm animal diets is therefore limited due to the fibre handling abilities of the livestock, which is about 5–7 percent (NRC, 1977 and Olomu, 1979).

Fibrous food ingredients are in abundant supply and cheaply too (Dogari, 1984). Efforts at evaluating the nutritional value of these by-products such as rice offal, maize offal, wheat offal and brewer's spent grains have been in progress for sometime in Nigeria with significant achievements (Babatunde *et al.*, 1975, and Adebowale and Ademosun, 1981). These fibrous feedstuffs have been shown to result in increased feed intake, lowering the rate of live weight gain and in poorer feed conversion ratios when they replaced maize in diets (Nelson, 1984; Maisamari, 1986; Atteh *et al.*, 1993; Tuleun *et al.*, 1998 and Oluolokun and Olaloku, 1999).

Non-ruminant animals lack the enzyme cellulase that can digest the components of the fibre in rice offal and other fibrous by products. This is so, at least in the small intestinal tract, which is the site for most nutrient absorption (Holness, 1991).

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 enzyme preparations with feedstuff (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 use of exogenous enzymes is known to help in the digestibility of feed ingredients and allow for the use of cheaper and poorer quality materials to obtain optimum performance.

There is a sizeable body of literature on the value of enhanced digestibility of roughages through the use of these enzymes with favourable results on growth performance, feed conversion efficiencies and on profitability of the enterprise (Broz and Frigg, 1993; Viveros *et al.*, 1994 and Tuleun *et al.*, 1998). The use of enzymes has been common in many industries for some years. For instance, enzyme uses in the food processing, brewing and leather-working industries are well documented (Partridge and Wyatt, 1995). An increased understanding of the properties of enzymes and their function has led to their introduction in the animal-feed industry, although the application of enzyme technology is relatively new for the livestock feed industry.

Enzymes have been approved for use in poultry feed because they are natural products of fermentation and therefore pose no threat to the animal or the consumer, (Vukic Vranjes 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. These NSPs cannot be digested by the endogenous enzymes of poultry and can have anti-nutritive effects. They cause an increase in viscosity of intestinal content and entrap large amounts of well digestible nutrients like starch and proteins. This leads to an impaired digestion and digestive problems, (Almirall *et al.*, 1995). Numerous researchers have demonstrated that the soluble NSP fraction and not the total NSP fraction are responsible for anti-nutritive responses. These NSPs can bind to large amounts of water and as a result, the viscosity of fluids in the digestive tract is increased. The increased viscosity causes problems in the small intestines because it reduces nutrient availability (particularly fat) and results in increased amount of sticky droppings (Choct *et al.*, 1995). Japanese quails (*coturnix coturnix japonica*) are small bodied birds of the galliforme family. They are highly prolific and hardy. Since they were introduced into the Nigerian poultry industry in 1992 (Haruna *et al.*, 1997), they have gained tremendous interest among Nigerian populace especially because of their short generation interval, fast growth rate and less susceptibility to common poultry diseases. Japanese quails in the wild, feed on insects, grains, grasses and various seeds. They have also been found to thrive well and grow efficiently in captivity when fed high protein diets (NVRI, 1996). Nevertheless, little research work has been done in the area of comparative ingredient evaluation for quail birds. The need for poultry species with lesser demand and low cost of production is more realistic when feed ingredients that are less competitive and available are used. This is the reason for considering sugarcane scrapping meal as an alternative feed source in quail diet. The aim of the study is therefore, to investigate the effects of exogenous enzyme supplementation of sugarcane scrapping meal-based diets on the growth rate and cost implication of finisher Japanese 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 found on latitude 08<sup>0</sup> 35'N and longitude 08<sup>0</sup> 33' E. The mean monthly maximum and minimum temperatures are 35. 06 and 20.16<sup>0</sup>C respectively while the mean monthly relative humidity is 74 %. The rainfall is about 168. 90mm. (NIMET, 2008)

### *Sugarcane scrapping*

Sugarcane scrapings were sourced from local sugarcane marketers within Lafia metropolis, sun-dried and milled to form the sugarcane scrapping meal.

### *Source of Maxigrain<sup>®</sup> enzyme*

Maxigrain<sup>®</sup> enzyme a multi-enzyme compound of  $\beta$ -glucanase, xylanase, phytase, arabinoxylanase and a mixture of yeast and minerals was purchased from Animal Care, Abuja.

### *Biochemical analysis*

The proximate analysis of sugarcane scrapings, basal, experimental diets and faecal samples of the experimental birds were done at the International Institute for Tropical Agriculture (IITA) Ibadan, using the procedure outlined by AOAC (2006) 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 a dry matter basis.

#### *Description and preparation of diets for finishing quails*

Six experimental diets tagged T<sub>10</sub>, T<sub>10</sub>100, T<sub>10</sub>200, T<sub>15</sub>, T<sub>15</sub>100 and T<sub>15</sub>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 3x2 factorial arrangement having 20 birds per replicate. Treatments T<sub>10</sub>, T<sub>10</sub>100, and T<sub>10</sub>200 contained 10% crude fibre while treatments T<sub>15</sub>, T<sub>15</sub>100 and T<sub>15</sub>200 contained 15% crude fibre level (high fibre level). The exogenous enzyme was included at 0, 100 and 200ppm thus, treatments T<sub>10</sub> and T<sub>15</sub> contained 0ppm, T<sub>10</sub>100 and T<sub>15</sub>100 contained 100ppm and T<sub>10</sub>200 and T<sub>15</sub>200 contained 200ppm of the enzyme supplementation such that treatments T<sub>10</sub> and T<sub>15</sub> served as the control for treatments T<sub>10</sub>100, and T<sub>10</sub>200 and T<sub>15</sub>100 and T<sub>15</sub>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.* (2007).

#### *Data collection*

The growth performance included body weight gain which was computed as the difference between the final weight and the initial weight of the birds, feed intake determined as the difference between the amount of feed fed and the leftover. Feed conversion ratio was calculated as the rate of feed intake to live weight gain while protein efficiency ratio was computed as the as the gain in body weight to the protein consumed. Water consumption determined accounting for evaporative loss using the procedure outlined by Shoremi *et al.* (2001). Mortality record was kept throughout the experimental period.

#### *Statistical analysis*

Data obtained were subjected to Two Ways 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:

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

Where Y<sub>ij</sub>= Individual observation

μ = general Mean

A<sub>i</sub> =effect of Factor A

B<sub>j</sub> =effect of Factor B

(AB)<sub>ij</sub>=effect of interaction AB

ε<sub>ijk</sub>=experimental error

## RESULTS AND DISCUSSION

Table 1 shows the proximate composition of sugarcane scrapping. The calculated metabolizable energy from the proximate composition data using the formula as described by Pauzenga (1985),  $ME \text{ (kcal/kg)} = 37x \% CP \times 81.1 \times \% EE + 35.5 \times \% NFE$  was about 29070.45. The test ingredient contains low (8.25%) crude protein, high crude fibre (36.48%) and low (3.36%) ether extract. The dry matter was about 90.67% while ash and nitrogen free extract were about 9.98 and 67.40% respectively. This composition makes sugarcane scrapping a fibrous feed material which will require some level of processing or pre-digestion if it must be fed to monogastric animals.

The non-significant variation in the final live weight, daily weight gain, daily feed intake, feed conversion ratio, protein efficiency ratio (Table 3) except for water intake which increased ( $P < 0.05$ ) with enzyme supplementation (126.20 vs. 142.10 and 106.26ml/day), feed cost per weight gain, cost of production, revenue and gross margin due to enzyme supplementation implies that enzyme supplementation improved the utilization of fibrous feeds although there was significant variation in daily weight gain. These observations are in agreement with the report of Mekanjuola and Iyayi (2010) who investigated the utilization of maize bran-based diets supplemented with Raxazyme G2G by broiler and observed that increased weight gain and feed intake were noted in birds fed the enzyme supplemented diets. This could be attributed to the fact that Maxigrain<sup>®</sup> enzyme broke down the fibre component in the feed thereby making available the nutrients to the birds. This is also in line with the report of McNab and Smithhand (1992), who reported that enzyme (Raxazyme G) complements the digestive enzyme of poultry to enhance the utilization of non-starch polysaccharides in cereals and their by products. The values reported in this study were slightly higher than the 1.58-1.78g earlier report (Tuleun *et al.*, 2009), but close to the 3.08-3.32 g/bird/day (Chantiratikul *et al.*, 2010) for weight gain. Dietary fibre reduced ( $P < 0.05$ ) final live weight (132.90 and 118.70 g/bird), daily weight gain (3.70 and 3.03g/bird/day), improved PER (0.73 and 0.46), water intake (138.41 and 119.22ml/bird/day) but reduced FCR (6.12 and 9.44) (Tables 4). Similarly, the cost benefit analysis parameters evaluated were significantly reduced ( $P < 0.05$ ) implying reduction in feed cost, as a result of the low cost of sugarcane scrapping. The result obtained confirms that Maxigrain<sup>®</sup> supplementation is suitable only with the use of feeds that exceed the recommended dietary fibre levels for optimum growth.

There was no significant difference ( $P > 0.05$ ) in the growth rate and cost benefit analysis due to the interactive effects of enzyme supplementation and dietary fibre (Tables 5). This observations are similar to the findings of Duru and Dafwang (2010) who investigated the effect of Maxigrain<sup>®</sup> enzyme supplementation of diets with or without rice offal on the performance of broiler chicks and noted that there was no significant variation in final body weight gain but feed intake was influenced significantly due to rice offal inclusion. Generally, birds tend to eat more feed when the level of fibre increases in the diets; this is in order to meet the calorie requirement of the bird which was in line with the trend recorded in this study. The values obtained in this study were within the range of 12.53-13.91g/bird/day for feed intake as reported by Bawa (2012a). Feed conversion ratio was better for chicks fed the low fibre diets and is an indication that chicks ate less to put a unit weight since the low fibre is a reflection of high energy density in the diets. The values obtained in the present study were close to the 12.53-13.91g/bird/day, 3.36-3.83 g/bird/day, and 3.27-3.84 for final weight, weight gain and feed conversion ratio earlier reported (Bawa, 2010).

## Conclusion and recommendation

Based on the conditions of this experiment, supplementing high level of sugarcane scrapping meal-based diets supplemented with Maxigrain<sup>®</sup> enzyme at 100pp is safe and economical for finishing quails.

## REFERENCES

- Adebowale, E.A. and Ademosun, A.A. (1981). The carcass characteristics and chemical compositions of the organs and muscle of sheep and goat fed brewer's dried grain based ration. *Tropical Animal production* 6(2): 133 – 137.
- Adegbola, T.A. (1989). A study of commercial poultry production in Anambra State. *J. Anim. Prod. Res.* 9 (2): 61-67.
- Almirall, M., Francesch, M., Perez-Venderell, A.M., Brutau, I., Esteve-Garcia, E. (1995). The differences in intestinal viscosity produced by barley and  $\beta$ -glucanase alter digesta enzymes activities in ileal nutrient digestibility more in broiler chicks than in cocks. *Journal of Nutrition*, 125:947-955.
- Alokan, J.A. (2000). Evaluation of water fern (*Azolla pinnata*) leaf meal in the diet of growing rabbits. In: Animal production in the new millennium: Challenges and options. Ukachukwu, S.N. Ibeawuchi, J.A., Ibe, S.N., Ezekwe, A.G. and Abasiokong, S.F. (eds). *Proceedings of the 25<sup>th</sup> Annual conference of Nigeria society for Animal Production*. 19<sup>th</sup> March, 2000, Umudike: pp 311-313.
- Atteh, J.O., Balogun, O.O., Annongu, A.A. and Kolade, M.A. (1993). Replacement value of Maize milling waste for maize in the diet of growing pullets. *Trop. Agric. (Trinidad)*, 70(3):267- 270
- Babatunde, G.M., Fetuga, B.L., Oyenuga, V. A. and Ayoade, J.A. (1975). The effect of graded levels of brewer's dried grain and Maize cob in the diet of pigs on their performance characteristics and carcass yield. *Nig. J. Anim. Prod.* 2 (1): 119 – 133.
- Babatunde, B.B., Adejinmi, O.O., Olupona, J.A., Omotoyin, O.E. and Tiamiyu, A. K. (2000). Effects of replacing Maize with graded levels of cocoa pod husks on performance of rabbits. In: Animal production in the new millennium: Challenges and options. Ukachukwu, S.N. Ibeawuchi, J.A., Ibe, S.N., Ezeke, A.G. and Abasiokong S.F. (eds). *Book of proceedings of 25<sup>th</sup> Annual Conference of the Nigeria in society for Animal Production*, 19<sup>th</sup> to 23<sup>rd</sup> March, 2000, Umudike, Abia State Nigeria. Pp 340 – 341.
- Bawa, G.S. (2012). Response of Japanese quail chicks (*Cortunix cortunix japonica*) to various dietary energy levels in a tropical environment. *Nig. J. Anim. Prod.* (39) 1:37-45
- Bio-ingredients Ltd. (2004). Practical use of Nutrase xyla<sup>®</sup> in animal feeding. Seminar paper presented in May 2004. Rony M. Ombaerts – Nutrex Behgium. PP. 10 – 16.
- Broz, M.J. and Frigg, M. (1993). Influence of *Trichoderma viridae* enzyme complex on nutritive value of barley and at on broiler chickens. *Arch. Creflugelk*, 54: 34 – 37.
- Chantiratikul, A., Chantiratikul, P., Sangdee, A., Maneechote, U., Bunchasak, C. and Chinrasri, O. (2010). Performance and carcass characteristics of Japanese quails fed diets containing wolffia meal (*Wolffia globosa* (L). *Wimm.*) as a protein replacement for soybean meal. *International Journal of Poultry Science* 9 (6): 562-566.
- Choct, M., Hughes, R.J., Wang, J., Bedford, M.R., Morgan, A.J. and Annison, G. (1995). Feed enzymes eliminate the anti-nutritive effect of non-starch polysaccharides and modify

- fermentation in broilers. Proceedings of the Australian Poultry Science Symposium, 7, Pp: 121-125.
- Dogari, M. (1984). Fibre in swine rations. A review paper. Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.
- Duru, S. and Dafwang, I.I. (2010). Effect of Maxigrain<sup>(R)</sup> supplementation of diets with or without rice offal on the performance of broiler chicks. *International Journal of Poultry Science* 9(8):761-764.
- Haruna, E.S.U., Musa, I.H., Lombin, D.B., Tat, D.D., Sharmaki, D.A. Okewola and Molokwu, J.V. (1997). Introduction of quail production in Nigeria. *Nig. Vet. J.*, 18: 104-107.
- Holness, D.H. (1991). *The Tropical Agriculturalist: Pigs*. The Macmillan Press Ltd. London and Basingstoke, PP. 49 – 59.
- Ikani, E.I. and Adesehinwa, A.O.K. (2000). Promoting non-conventional feed stuffs in livestock feeding. The need for extension strategy. In: Animal production in the new millennium: Challenges and options. Ukachukwu, S.N. Ibeawuchi, J.A., Ibe S.N., Ezekwe, A.G. and Abasiokong, S.F. (eds). *Book of proceedings of 25<sup>th</sup> Annual conference of the Nigeria in society for Animal Production, 19<sup>th</sup> to 23<sup>rd</sup> march, 2000*, Umudike, Abia State. Nigeria: pp. 366.
- Iyeghe-Erakpotobor, G.T. and Muhammad, I.R. (2004). Performance of breeding does fed concentrate and lablab combinations during pregnancy and lactation. In: sustaining livestock production under changing Economic Fortunes. *Proc.29<sup>th</sup> Conf., of Nig. Soc. for Anim. Prod.* 21<sup>st</sup> -25<sup>th</sup> March 2004. Usmanu Danfodiyo University, Sokoto, Nigeria. Pp. 191-195.
- Makanjuola, B.A. and Iyayi, E.A. (2010). Utilisation of maize bran-based diets supplemented with Roxazyme G2G by broilers. *Proc. 35<sup>th</sup> Conf., Nig. Soc. for Anim. Prod.* March 14<sup>th</sup>-17<sup>th</sup> 2010, University of Ibadan, Nigeria. Pp 426-428.
- Maisamari, B.A. (1986). Effect of levels and sources of wheat offal on Performance of chickens. M. Sc. Thesis. Ahmadu Bello University, Zaria, Nigeria.
- Musa, U., Haruna, E.S. and Lombin, L.H. (2008). Quail production in the tropics. Vom NVRI press. Pp 13, 24, 66-69.
- National Research Council (NRC) (1977). Nutrient requirements of poultry. National Academy Press, Washington D.C.
- Nelson, F.S. (1984). Replacement of maize in poultry rations with wheat offal and brewer's dried grains. M.Sc. Thesis, A.B.U., Zaria, Nigeria.
- NIMET (2008). Nigerian meteorological Agency, Lafia, Nasarawa state.
- NVRI (1996). Farmer training on quail production and health management. National Veterinary Research Institute, Vom. Nigeria.
- Olomu, J.M. (1979). Poultry production in Nigeria. Nutrient requirement of poultry in Nigeria. Publ. NAPRI, Shika, Zaria, Nigeria pp 241 – 249.
- Oluolokun, J.A. and Olaloku, E.A. (1999). The effects of graded levels of brewer's spent grains and kola nut pod meal on performance characteristics and carcass quality of rabbits. *Nig. J. Anim. Prod.* 26: 71 – 77.
- Orusebio, S.M. and Omu, P.B. (2000). The effect of lysine supplementation of commercial broiler feeds on the performance of broilers. In: Animal production in the new millennium: Challenges and options. *Proc. 25<sup>th</sup> Conf., of Nig. Soc. for Anim. Prod.* 19<sup>th</sup> to 23<sup>rd</sup> march, 200, Umudike, Abia State. Nigeria: pp 177-120.

- Partridge, G. and Wyatt, C. (1995). More flexibility with new generation of enzymes. *World poultry*, 11(4), 17-21.
- Pauzenga, U. (1985). Feeding parentstock. *Zootecnica International*. December 1985 PP.22 –24.
- Steel, R.G.D. and Torrie, J. H. (1980). Principles and procedures of statistics 2<sup>nd</sup> Ed. McGraw, Hill New York, U.S. A. 633pp.
- Tuleun, C.D., Njoku, P.C. and Yaakugh, I.D.I. (1998). The performance of pullet chicks fed Roxazyme®. *Proc. 3<sup>rd</sup> Conf., Anim. Sci. Assoc. Nig.*, Lagos, pp 74 – 76.
- Tuleun, C.D. Igyem, S.Y. and Adenkola, A.Y. (2009). The feeding value of toasted mucuna seed meal diets for growing Japanese quail (*Cortunix cortunix japonica*). *International Journal of Poultry Science* 8 (11): 1042-1046, 2009
- VanSoest, P.J. and Robertson, J.B. (1985). Analysis of forages and fibrous foods. As 613 manual. Department of Animal Science, Cornell University, Ithaca. Pp105- 106.
- Viveros, A., Brenes, A., and Pizzaro Mand castano, M. (1994). Effect of enzyme Supplementation of a diet based on barley and autoclave treatment, on apparent digestibility, growth performance and gut morphology of broilers. *Anim. Feed Sci. and Technol.* 48:237 – 251.
- Vukic Vranjes, M. and Wenk, C. (1993). Influence of dietary enzymes complex on broiler performance in diets with and without antibiotic supplementation. (In Wenk, C., Boessinger, M., ed., *Enzymes in animal nutrition.*) Kartuase Ittingen, Thurgau, Switzerland. Pp 152-155.

**Shoremi et al. (2001)**

**AOAC (2006)**

**Steel and Torrie (1980)**

**McNab and Smithhand (1992)**

Table 1. Proximate and energy composition of sugarcane scrapping

Nutrient	%
Crude protein	8.25
Crude fat	3.36
Crude fibre	36.48
Ash	9.98
Dry matter	90.67
NFE	67.40
<sup>a</sup> Energy (Kcal/kg ME)	2970.45

<sup>a</sup>Calculated from Pauzenga (1985)



Table 2. Proximate and chemical composition of finisher quails (*Cortunix cortunix japonica*) diets (%)

Nutrients	T10	T10 <sub>100</sub>	T10 <sub>200</sub>	T15	T15 <sub>100</sub>	T15 <sub>200</sub>
DM	89.26	89.28	89.71	89.14	89.95	89.03
CP	22.58	22.70	23.30	23.09	23.40	23.04
CF	10.21	10.16	10.13	15.27	15.78	15.38
EE	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
NFE	55.53	66.45	56.12	51.02	49.92	51.04
NDF	47.18	59.38	57.35	63.59	55.18	61.43
ADF	36.24	37.68	36.79	42.86	36.43	40.26
ADL	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
<sup>a</sup> Calcium	0.89	0.89	0.89	0.84	0.84	0.84
<sup>a</sup> Phosphorus	0.73	0.73	0.73	0.71	0.71	0.71
<sup>b</sup> Energy (Kcal/kg ME)	2852.26	2873.14	28159.30	2866.42	2884.26	2888.24

DM-Dry matter, CP-Crude protein, CF-Crude fibre, EE-Ether extract, NFE-Nitrogen-free extract, NDF-Neutral detergent fibre, ADF-Acid detergent fibre, ADL-Acid detergent lignin, <sup>a</sup> Calculated from NRC (1979), <sup>b</sup> Calculated from Pauzenga (1985)

Table 3. Effect of Maxigrain<sup>(R)</sup> enzyme supplementation on growth performance, water intake and economics of production of finisher quails (*Cortunix cortunix japonica*)

Performance indices	Main Treatment			Means	
	No Enzyme	100ppm Enzyme	200ppm Enzyme	SEM	LOS
Av. LW (g/bird)	55.02	55.01	54.92	0.07	NS
Av. FLW (g/bird)	126.60	126.70	124.10	3.74	NS
Av. DWG (g/bird/day)	3.40	3.41	3.29	0.18	NS
Av. DFI (g/bird/day)	25.02	25.26	24.53	0.46	NS
Av. FCR	7.90	7.67	7.76	0.52	NS
Av. PER	0.61	0.59	0.58	0.03	NS
Av. WI (ml/day)	126.20 <sup>b</sup>	142.10 <sup>a</sup>	106.26 <sup>b</sup>	13.42	*
<b>Economics of production</b>					
Av. FC/kg (N/kg)	79.86	80.04	80.21	-	-
Av. FC/WG(N/kg)	11.76	11.29	11.10	0.76	NS
Av. CP (N/bird)	43.90	38.60	37.80	4.36	NS
Av. Revenue (N)	680.00	681.00	658.00	35.80	NS
Av. Gross margin	644.00	641.00	620.00	31.70	NS

LW-Live weight, FLW-Final live weight, DWG-Daily weight gain, DFI-Daily feed intake, FCR-Feed conversion ratio, PER-Protein efficiency ratio, WI- Water intake, **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, FC-Feed cost, FC/WG-Feed cost per weight gain, CP-Cost of production.

Table 4. Effect of dietary fibre on growth performance, water intake and economics of production of finisher quails (*Cortunix cortunix japonica*)

Performance indices	Main Treatment		Means	
	Low Fibre	High Fibre	SEM	LOS
Av. LW (g/bird)	54.94	55.08	0.06	NS
Av. FLW (g/bird)	132.90 <sup>a</sup>	118.70 <sup>b</sup>	3.05	*
Av. DWG (g/bird/day)	3.70 <sup>a</sup>	3.03 <sup>b</sup>	0.15	*
Av. DFI (g/bird/day)	21.93 <sup>b</sup>	27.94 <sup>a</sup>	0.38	*
Av. FCR	6.12 <sup>b</sup>	9.44 <sup>a</sup>	0.43	*
Av. PER	0.73 <sup>a</sup>	0.46 <sup>b</sup>	0.03	*
Av. WI (ml/day)	138.41 <sup>a</sup>	119.22 <sup>b</sup>	14.20	*
<b>Economics of production</b>				
Av. FC/kg (N/kg)	87.80	71.92	-	-
Av. FC/WG(N/kg)	14.93 <sup>a</sup>	7.83 <sup>b</sup>	0.62	*
Av. CP (N/bird)	56.80 <sup>a</sup>	23.40 <sup>b</sup>	3.56	*
Av. Revenue (N)	741.00 <sup>a</sup>	605.00 <sup>b</sup>	29.30	*
Av. GM	684.00	586.00	25.90	*

LW-Live weight, FLW-Final live weight, DWG-Daily weight gain, DFI-Daily feed intake, FCR-Feed conversion ratio, PER-Protein efficiency ratio, WI- Water intake, FC-Feed cost, FC/WG-Feed cost per weight gain, CP-Cost of production, GM-Gross margin, 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 5. Effects of Maxigrain<sup>(R)</sup> enzyme supplementation and dietary fibre on growth performance and water intake of finisher quails (*Cortunix cortunix japonica*)

Performance indices	Main Treatment			Means			SEM	LOS
	T10	T10 <sub>100</sub>	T10 <sub>200</sub>	T15	T15 <sub>100</sub>	T15 <sub>200</sub>		
Av. LW (g/bird)	54.93	55.08	54.82	55.11	55.11	55.02	0.25	NS
Av. FLW (g/bird)	140.30	133.0	125.20	112.80	120.40	122.90	5.29	NS
Av. DWG (g/bird/day)	4.06	3.71	3.35	2.74	3.11	3.23	0.25	NS
Av. DFI (g/bird/day)	21.54	22.38	21.88	28.50	28.15	27.19	0.66	NS
Av. FCR	5.35	6.06	6.96	10.46	9.28	8.57	0.74	NS
Av. PER	0.83	0.71	0.66	0.41	0.47	0.51	0.05	NS
Av. WI (ml/day)	129.32	198.40	182.44	127.50	144.10	140.11	21.12	NS
Mortality (%)	15.00	5.00	0.00	10.00	5.00	5.00	-	-
<b>Economics of production</b>								
Av. FC/kg (N/kg)	87.80	87.98	88.15	71.92	72.10	72.27	-	-
Av. FC/WG(N/kg)	16.60	14.62	13.59	6.93	7.97	8.61	1.07	NS
Av. CP (N/bird)	68.60	54.40	47.40	19.10	22.80	28.30	6.16	NS
Av. Revenue (N)	812.00	741.00	670.00	548.00	621.00	646.00	50.70	NS
Av. GM	743.00	687.00	622.00	544.00	596.00	618.00	44.80	NS

LW-Live weight, FLW-Final live weight, DWG-Daily weight gain, DFI-Daily feed intake, FCR-Feed conversion ratio, PER-Protein efficiency ratio, WI- Water intake, FC-Feed cost, FC/WG-Feed cost per weight gain, CP-Cost of production, GM-Gross margin, 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.