FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 4 No. 1, March, 2020, pp 539 – 544

CARCASS CHARACTERISTICS OF JAPANESE QUAILS (*COTURNIX COTURNIX JAPONICA*) FED WHOLE OR GROUND PEARL MILLET (*PENNISETUM GLAUCUM*) WITH OR WITHOUT ENZYME SUPPLEMENTATION

[*1]Sabo, M. N., [2]Duru, S., and [3]Afolayan, S. B.

[*1]Department of Animal Science, Federal University Dutsin-Ma, Katsina State
[2]Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State
[3]Samaru College of Agriculture, Ahmadu Bello University, Zaria, Kaduna State

[*]Corresponding author's email: msabo@fudutsinma.edu.ng, mustynalado@gmail.com.

ABSTRACT
An experiment was conducted to evaluate the effect of dietary inclusion level (50% and 100%), form (whole or ground), and enzyme supplementation (with or without) of pearl millet at the expense of maize on the carcass characteristics of growing Japanese quails. Two weeks old unsexed Japanese quails were used in a 2 x 2 x 2 factorial arrangement in a completely randomized design with eight treatments and a control all replicated thrice in a four-week feeding trial. At the end of the 4th week, three quails per treatment were used for carcass evaluation. The quails were fasted, weighed and slaughtered by severing the jugular vein. They were defeathered and eviscerated manually. Weight of the carcass and different parts of the gut were measured using a digital scale and recorded. The results of the study showed that dressing percentage, gizzard weight and liver weight were not affected by dietary inclusion level, form or enzyme supplementation of pearl millet diets. Inclusion of 100% pearl millet, feeding ground pearl millet and pearl millet without enzyme led to increased intestinal weight relative to the control. Quails fed pearl millet without enzyme had heavier proventriculus (0.42T%) than those fed the control (0.35%). Whole and ground pearl millet can conveniently replace maize in the diet of Japanese quails without any adverse effects.

Keywords: Quails, Millet, Enzyme, Carcass, Whole

INTRODUCTION

The particle size of feed (e.g., coarsely ground mash vs. whole grains) has been shown to have a strong effect on the morphological and physiological function of the poultry gastrointestinal tract (Matthias and Hasan, 2003; Enberg *et al*., 2004). Blair (2008) reported that several research findings have demonstrated that whole grain feeding has beneficial effects on the overall health of poultry. They revealed that a better-developed gizzard has an important function as a barrier organ in preventing pathogenic bacteria from entering the distal digestive tract. Whole grains feeding prevents proventricular dilatation and mortality related to ascites (Enberg *et al*., 2004). Feeding whole grain limits microbial growth by stimulating gizzard activity and manipulating digesta pH (Leeson and Summers, 2005). This reduces many enteric diseases and skeletal problems in poultry (Bennett *et al.*, 2002; Svihus and Hetland, 2004; Biggs and Parsons, 2009).

Svihus (2010) hypothesized that a more developed gizzard as a consequence of structural components may improve efficacy of exogenous enzymes. This could be due to increased retention time in the gizzard and the favourable pH there. Particle size influences retention time in the digestive tract (Patrick, 2004).

Pearl millet (P*ennisetum glaucum*) is native to the western edges of the Sahara Desert (Hidalgo *et al*., 2004). Pearl millet grows under difficult ecological conditions, tolerates poor soils better than other cereal crops and it appears to be tolerant of acidic soils with low fertility (Dozier *et al*., 2005; Sade, 2009). From nutritional stand point, pearl millet is an attractive feed grain for non-ruminant animals as it combines a high level of metabolizable energy with up to 50% increase in protein compared to maize. Most strikingly, is the level of the critical amino acids lysine and methionine, in which pearl millet is 40% richer than maize (Abubakar *et al.*, 2006; Dale, 2006). The high fibre level of pearl millet could be a limiting factor to its use in poultry diets. The utilization of this fibre could be improved with the use of exogenous enzymes (Singh and Perez-Maldonado, 1999).The objective of this study was to determine the effect of pearl millet inclusion level, pearl millet form and enzyme supplementation of pearl millet diets as replacement for maize on carcass characteristics of growing Japanese quails.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Unit of the Research and Training Farm of the Department of Animal Science, Ahmadu Bello University Zaria, located within Northern Guinea Savannah Zone of Nigeria at latitude 11˚ 09' 06″N longitude 7˚ 3' 8″E having a tropical continental climate with marked periods of rainfall ranging from 1102mm to 1904mm.

The mean temperature fluctuates from 31ºC maximum and 18ºC minimum depending on season (as reported by Hassan *et al.,* 2013).

Experimental design, birds and their management

Two weeks old Japanese quails were used in a 2 x 2 x 2 factorial arrangement in a completely randomized design with two levels of millet inclusion (50 and 100%) as replacement for maize, two forms of millet (whole or ground) and enzyme supplementation (with or without) was used in this experiment. The birds were allocated to nine dietary treatments with each treatment having three replicates and 14 birds per replicate. The birds were reared in constructed cages and all routine management practices were strictly adhered to. The birds were given the experimental diets from the end of the second week until 42 days of age.

Experimental diets

A maize based layer diet was formulated according to the NRC (1994) recommendation (24% CP and 2900MEkcal/kg) as the control. Pearl millet replaced maize on a weight to weight basis for the different inclusion levels and forms and each with or without enzyme supplementation (table 1).

Treatment 1 (control) ----------0% pearl millet
Treatment 2 ----------50% whole pearl millet
Treatment 3 ----------50% whole pearl millet with enzyme
Treatment 4 ----------100% whole pearl millet
Treatment 5 ----------100% whole pearl millet with enzyme
Treatment 6 ----------50% pearl ground millet
Treatment 7 ----------50% ground pearl millet with enzyme
Treatment 8 ----------100% pearl ground millet
Treatment 9 ----------100% ground pearl millet with enzyme

The exogenous enzyme used in this study was Maxigrain®. 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.

Measurements

Proximate analysis

Proximate analysis of representative samples of the experimental diets was carried out according to methods described by AOAC (2003) at the Department of Animal Science Biochemical Laboratory of Ahmadu Bello University, Zaria.

Carcass evaluation

At the end of the growing period (42 days), carcass evaluation was carried out using three quails around the average live body weight of each treatment. The quails were fasted, then individually weighed to the nearest gram, and slaughtered by severing the jugular vein. Few minutes after bleeding, each bird was dipped into a hot water bath for two minutes, and feathers were removed manually. After the removal of the head, the carcasses were eviscerated manually, they were then weighed to obtain carcass weight. Dressing percentage was determined. Weights of different parts of the gut were measured using a digital scale and recorded.

$$\text{Dressing percentage (\%)} = \frac{\text{Carcass weight (g)} \times 100}{\text{Live weight (g)}}$$

Statistical Analysis

Data obtained from the experiment were analyzed using the general linear models (GLM) procedure of SAS software (SAS, 1994). Data were subjected to analysis of variance. Where the analysis of variance was significant, Duncan's multiple range test (Duncan, 1955) was used to separate treatment means other than control (0%PM) (Steel and Torrie, 1980). The control was contrasted from each of the treatments using Dunnett test at 5% level of probabilty.

Table 1: Composition (%) of Experimental Diets

Ingredients	0%Pearl Millet	50% Pearl Millet	100% Pearl Millet
Maize	46.0	23.0	-
Pearl millet	-	23.0	46.0
Soyabean meal	20	20	20
Groundnut cake	25	25	25
Maize offal	3.25	3.25	3.25
Palm oil	2.0	2.0	2.0
Limestone	1.0	1.0	1.0
Bone meal	2.0	2.0	2.0
Salt	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25
Lysine	0.10	0.10	0.10
Methionine	0.15	0.15	0.15
Maxigrain	-	-	-
Total	100	100	100
Calculated analysis			
Crude protein (%)	24.8	25.4	25.9
ME (kcal/kg)	2896	2696	2495
Ether extract (%)	2.1	2.1	2.1
Crude fibre (%)	3.14	4.4	5.6
Calcium (%)	1.2	1.2	1.4
Phosphorus (%)	0.7	0.7	0.6
Lysine (%)	1.3	1.3	1.4
Methionine (%)	0.5	0.5	0.5
Feed cost(₦/kg)	95.82	97.53	101.44

RESULTS AND DISCUSSION

Proximate Composition of the Experimental Diets

Tables 2 shows the proximate composition of the starter diet and proximate composition of the layer diet respectively. With increase in the inclusion of pearl millet there was gradual increase in protein, fibre and ash but decrease in ether extract and nitrogen free extract. These agree with previous observations that millet has lower metabolizable energy, higher crude protein, crude fibre and ash than maize (Abubakar *et al.,* 2006; Dale, 2006).

Table 2: Proximate composition (%) of feed samples

Parameter	0% Pearl Millet	50% Pearl Millet	100% Pearl Millet
Dry Matter	92.21	92.56	92.80
Crude Protein	25.04	26.25	27.45
Crude Fibre	8.65	8.94	9.75
Ether extract	5.32	5.22	5.01
Ash	9.44	11.1	11.15
Nitrogen free extract	51.55	48.49	46.64

Effect of pearl millet inclusion level on the carcass characteristics of growing Japanese quails

The main effect of Pearl Millet inclusion level on the carcass characteristics of growing Japanese quails are presented on table 3. Growing Japanese quails fed the two pearl millet inclusion levels had similar ($P>0.05$) carcass weight, dressing percentage, gizzard weight, weight of proventriculus and liver weight with the control However, growing Japanese quails fed 100% millet had a heavier ($P<0.05$) intestine than that of quails fed maize. Both 50 and 100% millet fed groups had similar ($P>0.05$) intestinal weights. The intestinal weights of quails fed 50% millet and maize were also similar ($P>0.05$). Almost similar to these results is the observation of Davis *et al.* (2003) who found that up to 50% pearl millet grain as replacement for maize in broiler diets did not adversely affect carcass yields. Substituting yellow maize with pearl millet resulted in similar dressing percentage, gizzard weights and intestinal weight but higher liver weight (Rao *et al.,* 2004). The higher intestinal proportion observed in this study in quails fed the 100% pearl millet diet compared to the control (0% pearl millet) may be due to higher fibre content of the pearl millet.

Table 3: Main effect of Pearl Millet inclusion level on the carcass characteristics of growing Japanese quails

	PEARL MILLET INCLUSION LEVEL			
Parameter	**Control**	**50%**	**100%**	**SEM**
Live weight (g/bird)	111.67	110.75	111.50	1.90
Carcass weight (g/bird)	78.00	76.67	75.83	1.33
Dressing percentage (%)	69.85	69.24	68.05	0.65
Weight of organs expressed as a percentage (%) of carcass weight				
Gizzard	2.64	2.53	2.56	0.10
Proventriculus	0.35	0.41	0.40	0.014
Intestine	3.23^{b}	3.68^{ab}	3.85^{a}	0.15
Liver	1.39	1.35	1.37	0.10

$^{a, b, c}$ means in a row with no common superscript(s) differ significantly (P<0.05)
SEM – standard error of mean,

Higher levels of fibre might have increased the physical activity of digestive organs in an effort to grind and digest them resulting in hypertrophy or hyperplacia of these organs (Rao *et al.*, 2004). Matthias and Hasan (2003) explained that switching from a standard diet to a high-fibre diet, increases the sizes of gizzard muscle and small intestine of Japanese quails. In the small intestine, decreasing quality of the food may be compensated by increasing intestinal length, circumference and surface magnification. With increasing digestive load to the intestine we also expected the muscle layer to thicken.

Effect of pearl millet form on the carcass characteristics of growing Japanese quails

Growing Japanese quails fed either whole or ground pearl millet as replacement for maize had similar carcass weight, dressing percentage, gizzard weight, weight of proventriculus and liver weight but different intestinal weights (Table 4). Quails fed ground pearl millet as replacement for maize recorded significantly higher (P<0.05) intestinal weight than quails fed maize or whole pearl millet based diets. The intestinal weights of quails fed whole millet and maize were statistically similar. Similar to these results, Umar Faruk *et al.* (2010a) reported similar weights of duodenum and ileum, gizzard, liver pancreas and proventriculus when whole pearl millet was fed to laying hens compared to the feeding of ground pearl millet. In contrast to these results, Engberg *et al.* (2004) found that the relative weights of gizzard and pancreas were influenced by the form of the wheat and was higher in birds fed whole wheat compared with pellet-fed birds. Dietary particle size is known to influence the avian digestive tract such that the gizzard weight increases with increasing particle size (Garcia, 2006; Umar Faruk *et al.*¸2010a).

Table 4: Main effect of Pearl Millet form on the carcass characteristics of growing Japanese quails

	PEARL MILLET FORM			
Parameter	**Control**	**Whole Pearl Millet**	**Ground Pearl Millet**	**SEM**
Live weight (g/bird)	111.67	110.17	112.08	1.90
Carcass weight (g/bird)	78.00	75.00	77.50	1.33
Dressing Percentage (%)	69.85	68.09	69.19	0.65
Weight of organs expressed as a percentage (%) of carcass weight				
Gizzard	2.64	2.52	2.57	0.10
Proventriculus	0.35	0.40	0.41	0.014
Intestine	3.23^{b}	3.55^{ab}	3.97^{a}	0.15
Liver	1.39	1.21	1.50	0.10

$^{a, b, c}$ means in a row with no common superscript(s) differ significantly (P<0.05)
SEM – standard error of mean

Effect of enzyme supplementation of pearl millet based diets on the carcass characteristics of growing Japanese quails

Growing Japanese quails fed pearl millet with or without enzyme supplementation as replacement for maize had similar carcass weight, dressing percentage and weights of gizzard and liver. Enzyme supplementation affected the weights of proventriculus and intestine of growing Japanese quails fed pearl millet as replacement for maize (Table 5). Quails fed pearl millet without enzyme supplementation recorded proventricular weight higher (P<0.05) than that of quails fed maize but similar to that of quails fed millet with enzyme supplementation. Quails fed either maize or millet with enzyme supplementation or maize had similar proventricular weights. Quails fed millet with enzyme supplementation recorded intestinal weight higher (P<0.05) than that of quails fed maize but similar to that of quails fed millet without enzyme supplementation. Quails fed either maize or millet without enzyme supplementation or maize had similar intestinal weights. Similar with the results of this study, Rao *et al.* (2004) observed that enzyme supplementation of pearl millet diets as replacement for maize did not affect the dressing percentage, gizzard, liver and intestinal weights of broilers. Arumbackam *et al.* (2004) also observed no difference in carcass characteristics as a result of enzyme supplementation. In contrast, Engberg *et al*. (2004) observed that the addition of xylanase resulted in a reduction of the weight of jejunum and ileum. The higher percentages of the intestine observed in this study in

quails fed the pearl millet without enzyme supplementation compared to the control (0% pearl millet) may be due to higher fibre content of the pearl millet based diets. Higher levels of fibre might have increased the physical activity of digestive organs in an effort to grind and digest them resulting in hypertrophy or hyperplacia of these organs (Rao *et al*., 2004). Enzyme supplementation hence did reduce the load of increased fibre in pearl millet diets on the digestive organs as quails fed that diet had similar gizzard, proventricular and intestinal weights. This was earlier opined by Sheppy (2001) that the supplementation of animal feeds with enzymes is to increase the efficiency of digestion and is an extension of the animal's own digestive process.

Table 5: Main effect of Enzyme supplementation of pearl millet diets on the carcass characteristics of growing Japanese quails

		ENZYME		
Parameter	**Control**	**PM-EN**	**PM+EN**	**SEM**
Live weight (g/bird)	111.67	110.50	111.75	1.90
Carcass weight (g/bird)	78.00	76.42	76.08	1.33
Dressing Percentage (%)	69.85	69.17	68.12	0.65
Weight of organs expressed as a percentage (%) of carcass weight				
Gizzard	2.64	2.58	2.51	0.10
Proventriculus	0.35[b]	0.42[a]	0.39[ab]	0.014
Intestine	3.23[b]	3.87[a]	3.65[ab]	0.15
Liver	1.39	1.44	1.27	0.10

[a, b, c] means in a row with no common superscript(s) differ significantly (P<0.05)SEM – standard error of mean PM-EN: pearl millet without enzyme
PM+EN: pearl millet with enzyme

CONCLUSION AND RECOMMENDATION

The results of this study showed that complete replacement of maize with ground pearl millet without enzyme supplementation increased the intestinal weight while enzyme supplementation increased the weight of proventriculus of growing Japanese quails. Carcass yield, gizzard weight and liver weight were not affected by dietary inclusion level, form or enzyme supplementation of pearl millet diets. It is therefore recommended that where the price of pearl millet is lower than that of maize, whole pearl millet can replace maize in the diets of growing and laying Japanese quails without enzyme supplementation.

REFERENCES

Abubakar, A., Bashar, Y. A. and Eguke B. O. C. (2006). Pearl millet as substitute for maize in the diets of broiler chickens in Sokoto, Nigeria. *Tropical Journal of Animal Science*, 9(2): 53-61.

AOAC (2003). Official methods of analysis of the Association of official analytical chemist, 17th edition. Association of official analytical chemist, Arlington, Virginia, U.S.A.

Arumbackam, V. E., Asit, B. M., Pramod, K T., Praveen, K. T., Saroj, T. and Tripurari, S. J. (2004). Effects of enzymes in diets with varying energy levels on growth and egg production performance of Japanese quail. *Journal of the Science of Food and Agriculture*, Volume 84, Issue 15, Pp 2028–2034. DOI: 10.1002/jsfa.1910

Blair, R. (2008). Nutrition and feeding of organic poultry. Wallingford, UK: CABI.

Dale, N. M. (2006). Pearl millet for layers: A new opportunity. *Commercial Egg Tip*. The University of Georgia, Cooperative Extension Service College of Agricultural and Environmental Sciences, Athens, Georgia.

Dozier, W. A., Hanna, W. and Behnke, K. (2005). Grinding and pelleting responses of pearl millet-based diets. *Journal of Applied Poultry Research*, 14:269–274.

Engberg, R. M., Hedemann, M. S., Steenfeldt, S., and Jensen, B. B. (2004). Influence of whole wheat and xylanase on broiler performance and microbial composition and activity in the digestive tract. *Poultry Science, 83*: 925–938.

Garcia, A. R. and Dale, N. M. (2006). Feeding of unground pearl millet to laying hens. *Journal of Applied Poultry Research*, 15:574–578. Retrieved 27th August, 2013 from http://japr.fass.org/content/15/4/574.full.pdf+html

Hassan, M. R., Amodu, J. T., Abdu, S. B., Adamu, H. Y., Enaohwo, A., Adedibu, I. I., Tamburawa, M. S. and Abia, E. (2013). Dry Leaves of African Black Plum (*Vitex doniana L. Sweet*) as Option for Smallholder Goat Keepers in Nigeria. *Advances in Agriculture, Sciences and Engineering Research*, Vol 3, No 8.

Hidalgo, M. A., Davis, A. J., Dale, 1 N. M. and Dozier, W. A. (2004). Use of whole pearl millet in broiler diets. *Journal of Applied Poultry Research*, 13:229-234.

Leeson, S. and Summers, J.D. (2005). Commercial Poultry Nutrition, Third Edition. Nottingham University Press, Nottingham,England.

Matthias, S. J. and Hasan, G. A. (2003). Phenotypic flexibility of structure and function of the digestive system of Japanese quail. *The Journal of Experimental Biology* 206, 1887-1897.

National Research Council, (1994). *Nutrient requirement of poultry*. 9th revised edition. National Academy of Sciences, Washington DC. 45pp

Rao, R. S. V., Raju, M. V. L. N., Reddy, M. R. and Panda, A. K. (2003). Replacement of Yellow Maize with Pearl Millet (*Pennisetum typhoides*), Foxtail Millet (*Setaria italica*) or Finger Millet (*Eleusine coracana*) in Broiler Chicken Diets Containing Supplemental Enzymes

Sade, F. O. (2009). Proximate, antinutritional and functional properties of processed pearl millet. *Journal of Food Technology*, 7(3): 92-97.

Sheppy, C. (2001). The current feed enzyme market and likely trends. In Bedford, M. R. and Partridge, G. G. (eds) (2001). Enzyme in Farm AnimalNutrition, CABI Publishing, UK

Singh, D. N. and Perez-Maldonado, R. (1999). Nutritional value of pearl millet as poultry feed. A report for the Rural Industries Research and Development Corporation. RIRDC Project No DAQ-243A

Statistical Analysis System, (1994). Statistical users guide. SAS institute Inc. Cary, North Carolina, U.S.A.

Steel, R.O.G. and Torrie, J.H. (1980). Principles and Procedures of Statistics. A biometrical approach. Students edition. McGraw-Hill Int. Books Co. London.

Svihus, B. (2010). Challenging current poultry feeding dogmas by feed intake restriction and the use of coarse feed ingredients. In P. Selle (Ed) 21st *Annual Australian Poultry Science Symposium Sydney*, New South Wales, 1 – 3 February, 2010.

Svihus, B. and Hetland, H. (2004). Feed particle size and dietary fibre affect nutrient utilization. Agricultural University of Norway, As. Norway.

Umar Faruk, M., Bouvarel, I., Meme, N., Rideau, N., Roffidal, L., Tuur, H.M., Bastianelli, D., Nys, Y., Lescoat, P. (2010a) Sequential feeding using whole wheat and a separate protein-mineral concentrate improved efficiency in laying hens. *Poultry Science* 80:785-796.