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FEEDING WHOLE PEARL MILLET (*PENNISETUM GLAUCUM*) WITH OR WITHOUT ENZYME SUPPLEMENTATION TO GROWING JAPANESE QUAILS (*COTURNIX COTURNIX JAPONICA*)

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ABSTRACT

An experiment was conducted to evaluate the effect of dietary inclusion level (50% or 100%), form (whole or ground), and enzyme supplementation (with or without) of pearl millet at the expense of maize on the performance of growing Japanese quails. A total of 378 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 with 14 quails per replicate in a four-week feeding trial. Feed intake and weight gain were measured weekly. Three quails per treatment were used for carcass evaluation. The results obtained showed that weight gain, age at first lay, weight at first lay and weight of first egg were similar (P>0.05) among the treatments. Feed intake, feed conversion ratio, total feed cost and feed cost/kg gain were significantly affected (P≤0.05) by pearl millet inclusion with the control group doing better than either of the pearl millet inclusion levels of 50% or 100%. Whole pearl millet can conveniently replace maize in the diet of Japanese quails without any adverse effects.

Keywords: pearl millet; Japanese quails; nutrients; digestibility

INTRODUCTION

Feed is the most expensive portion (70-80%) of the cost of raising poultry and this expense is magnified by the fact that most farmers feed ground mash or pelleted diet (Schivera, 2003). In an attempt to reduce this cost, feeding whole grains to poultry is now becoming a common management practice used frequently in Europe, Australia, and Canada (Bennett *et al.*, 2002). This practice reduces feed costs and wastage due to handling, processing, transportation and storage (Bennett *et al.*, 2002; Schivera, 2003; Hidalgo *et al*., 2004; Garcia and Dale, 2006; Biggs and Parsons, 2009; Svihus, 2010). Apart from saving costs, many benefits attributed to feeding whole grains include increased gizzard activity (Bennett *et al.*,2002; Engberg *et al*., 2004; Svihus and Hetland, 2004; Garcia and Dale, 2006; Biggs and Parsons, 2009; Svihus, 2010), increased pancreatic enzyme secretion (Svihus and Hetland, 2004; Svihus, 2010), increased efficiency of exogenous enzymes (Svihus, 2010), increased starch and amino acid digestibility (Engberg *et al*., 2004; Garcia and Dale, 2006; Biggs and Parysons, 2009; Svihus, 2010), greater apparent metabolizable energy (Biggs and Parsons, 2009), improvement in feed conversion ratio (Bennett *et al.*,2002; Engberg *et al*., 2004; Garcia and Dale, 2006) and an indirect effect on reducing many enteric diseases and skeletal problems in poultry (Svihus, 2001; Bennett *et al.*, 2002; Engberg *et al*., 2004; Svihus and Hetland, 2004; Biggs and Parsons, 2009).

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). Feed particle size influences retention time in the digestive tract. The larger the particle size, the longer feed is retained, the greater its exposure to endogenous and exogenous enzymes and subsequently the greater the nutrients utilization (Patrick, 2004). 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. 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 performance 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, Kaduna state, Nigeria, located within Northern Guinea Savannah Zone of Nigeria at latitude 11˚ 09' 06″N longitude 7˚ 3' 8″E with an altitude of 706m above sea level (GPS) and having a tropical continental climate with marked periods of rainfall ranging from 1102 mm to 1904 mm. The mean temperature fluctuates from 31^{o}C maximum in dry season to 18^{o}C minimum in wet season (as reported by Hassan *et al.,* 2013).

Experimental birds and their management

Two weeks old Japanese quails were sourced from a private farm in Jos, Plateau state. The birds were reared in constructed cages and all routine management practices were strictly adhered to. Feed and water were provided *ad libitum*. The birds were given the experimental diets from the end of the second week until 42 days of age (growing period).

Experimental design

A total of 378 two weeks old unsexed Japanese quails were used in 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). The birds were allocated to nine dietary treatments with each treatment having three replicates and 14 birds per replicate.

Experimental diets

Ingredients for the experimental diets were obtained from local markets and feed millers within Zaria, Kaduna state, Nigeria. A maize based grower 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 analyses of pearl millet and that of representative samples of the experimental diets were carried out according to methods described by AOAC (2003).

Feed intake and live weight gain and mortality

A given quantity of feed was measured and fed to the birds on a weekly basis. From which weekly feed intake was measured. Daily feed intake and total feed intake were determined. The birds were weighed early in the morning before receiving any feed and water using a weighing balance at weekly intervals during the experimental period. Initial and final body weights of the Japanese quails were measured at the beginning and end of the experiment respectively. Average daily weight gain and feed conversion ratio were determined. Mortality was recorded as it occurred.

Point of lay parameters

Age at first lay, weight at first lay and weight of first egg were measured and recorded immediately the first egg was laid for each treatment.

Statistical Analysis

Data 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 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%.

RESULTS AND DISCUSSION

Proximate Composition of the Experimental Diets

Table 2 shows the proximate composition of the experimental diets.

Effect of pearl millet inclusion level on the performance of growing Japanese quails

Growing Japanese quails fed 50 and 100% pearl millet had similar ($P>0.05$) final body weight, weight gain, average daily weight gain, age at first lay, weight at first lay and weight of first egg compared to the control (0% pearl millet) as shown in Table 3. This agrees with the findings of Davis *et al.* (2003) who observed that completely replacing maize with pearl millet from 1 to 16 days and replacing 50% of maize with pearl millet from 0 to 42 days in the diets of broilers did not had any adverse effect on their performance. The above results also agreed with the findings of Reddy *et al.* (2006) who showed that when pearl millet replaced maize part per part or isocalorically and isoproteinically the performance of chicks was either comparable or better than that of chicks fed maize. In contrast, Hafeni (2013) observed that broiler chickens fed pearl millet based diets gained significantly more weight than those fed maize based diets. Tornekar *et al*. (2009) also reported that up to 50% replacement of maize with pearl millet resulted in increased body weights of broilers. The

similarity of the above mean values obtained in the assessed parameters in this study could likely be due to the level of metabolizable energy in the pearl millet which is close to that of maize and its higher protein content compared to maize (Abubakar *et al.,* 2006; Dale, 2006).

Table 1: Composition (%) of Experimental Diets

Ingredients	0%PM	50%PM	100%PM
Maize	46.0	23.0	-
Pearl millet	-	23.0	46.0
Soya-bean 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
Premix	0.25	0.25	0.25
Lysine	0.10	0.10	0.10
Methionine	0.15	0.15	0.15
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

PM- pearl millet

Table 2: Proximate composition (%) of feed samples

Parameter	0%PM	50%PM	100%PM
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

PM- pearl millet

Total feed intake, average daily feed intake, feed conversion ratio, total feed cost and feed cost/kg gain, were significantly affected ($P<0.05$) by varying levels of pearl millet inclusion. Total feed intake and average daily feed intake were higher ($P<0.05$) for birds fed either of the two levels of pearl millet (50 and 100%) when compared with that of the control group. However, the two pearl millet inclusion levels were similar ($P>0.05$) with regard to these

performance parameters. The increase in total feed intake and average daily feed intake observed in this study agrees with the findings of Tornekar *et al*. (2009), who observed that broilers fed pearl millet as replacement for maize consumed more feed than those fed maize. The results of this study disagree with the of findings of Hafeni (2013) who observed that replacement of maize with pearl millet had no significant effect on feed intake of broiler chickens from 21 to 49 days of age. In the same vein, it was also observed in this study that the feed conversion ratio of growing Japanese quails fed maize was superior ($P<0.05$) to that of those fed the either levels (50% or 100%) of pearl millet. The two millet inclusion levels had similar ($P>0.05$) feed conversion ratio. This agrees with the observation of Tornekar *et al*. (2009) that broilers fed maize had lower feed conversion ratio than those fed pearl millet. In contrast, Udeybir *et al.* (2009) reported similar feed conversion ratio both in 50% pearl millet diet and 100% maize as fed to broilers. Hafeni (2013) also observed that replacement of maize with pearl millet had no significant effect on feed conversion ratio of broiler chickens from 21 to 49 days of age. The higher feed intake and feed conversion ratio with increasing levels of pearl millet recorded in this study may be attributed to reduced energy with increasing levels pearl millet inclusion (Tables 1 and 2). Under normal circumstances, birds would eat to satisfy their energy needs and birds fed with low energy diets compensate for the lower energy concentration by increasing feed intake (Akinola and Sese, 2012). Also the results of proximate analysis of the experimental diets as showed increase in crude fibre content with increase in pearl millet inclusion (Table 2). Increase in feed intake with increased levels of fibre in the diet has been reported by many researchers (Mateos *et al.*, 2012; Michard, 2011). Fibre usually dilutes the energy content (and other nutrients) of diets and this increases feed intake (Michard, 2011). Apart from that, increased dietary fibre generates physical distension of the walls of the gastro-intestinal tract, increasing gastro-intestinal capacity and gut fill and these results in increased feed intake (Mateos *et al.*, 2012; Matthias and Hasan, 2003).

Table 3: Main effect of Pearl Millet inclusion levels on the performance of growing Japanese quails

	Pearl Millet Inclusion Level			
	Control	50%	100%	SEM*
Parameter				
Initial weight (g/bird)	35.47	35.63	35.26	1.11
Final weight (g/bird)	129.49	135.66	137.54	2.86
Total weight gain (g/bird)	94.02	100.03	102.28	2.48
Average daily weight gain (g/bird)	3.36	3.57	3.65	0.09
Total feed Intake (g/bird)	307.30^{b}	367.78^{a}	372.53^{a}	5.98
Average daily feed intake (g/bird)	10.97^{b}	13.14^{a}	13.30^{a}	0.21
Feed conversion ratio	3.27^{a}	3.68^{b}	3.66^{b}	0.06
Total feed cost (₦/bird)	29.45^{a}	36.38^{b}	38.31^{b}	0.65
Feed cost/kg gain (₦)	313.31^{a}	364.25^{b}	376.39^{b}	6.38
Age at first lay (days)	42.33	41.08	40.67	0.50
Weight at first lay (g/bird)	128.85	131.56	134.15	2.98
Weight of first egg (g)	7.33	7.75	7.50	0.23

$^{a, b, c}$ means in a row with no common superscript(s) differ significantly ($P<0.05$)

SEM – standard error of mean

* The SEM is for comparison between the 2 pearl millet inclusion levels. Comparison with the control was done using Dunnet's test

Total feed cost and feed cost/kg gain were higher (P<0.05) for birds fed either of the two levels of pearl millet (50 and 100%) when compared with that of the control group. The two millet inclusion levels had similar (P>0.05) total feed cost and feed cost/kg gain. The higher total feed cost and feed cost/kg gain in the pearl millet fed groups is due to the price (as at that time in the experimental location) of pearl millet which was higher than that of maize (₦96/kg vs. ₦70/kg) as well as the higher feed intake observed in the pearl millet fed groups.

Effect of pearl millet form on the performance of growing Japanese quails

Results of the effect of pearl millet form on the performance of growing Japanese quails are shown in Table 4. Growing Japanese quails fed either ground or whole pearl millet (unground) had similar (P>0.05) performance parameters. Hence, grinding of pearl millet had no effect on the performance of growing Japanese quails. These results confirm the observations of Dale (2006) which show that high levels of pearl millet can be fed in unground form. It also agrees with the assertion of Biggs and Parsons (2009), that most studies reported that the early growth of chickens is unaffected by the inclusion of a whole grain.

Feeding either unground or ground pearl millet to growing Japanese quails as replacement for maize significantly affected (P<0.05) total feed intake, average daily feed intake, feed conversion ratio, total feed cost and feed cost/kg gain. Quails fed either unground or ground pearl millet based diets have higher (P<0.05) total feed intake, average daily feed intake, feed conversion ratio, total feed cost and feed cost/kg gain compared to those fed the control (0% pearl millet). Since the two pearl millet forms (whole and ground) recorded similar (P>0.05) performance parameters, the higher feed intake and feed conversion ratio of the pearl millet fed groups compared to the control may as well be attributed to the reduced energy and higher fibre content of the pearl millet based diets which resulted in increased feed intake as discussed earlier. These results however, disagree with the findings of Hidalgo *et al*. (2004) and UKCAG (2012), who reported that feeding whole pearl millet seeds to broilers resulted in feed conversion and weight gain equivalent to that of broilers fed standard maize-soybean diet at the end of the starter, grower and finisher periods of age. The higher (P<0.05) total feed cost and feed cost/kg gain is due to the higher feed intake as well as the price of pearl millet which was higher than that of maize (₦96/kg vs ₦70/kg).

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

The result of the effect of enzyme supplementation on the performance of growing Japanese quails is shown in Table 5. Feeding pearl millet based diets with or without enzyme supplementation to growing Japanese quails as replacement for maize affected (P<0.05) total feed intake or average daily feed intake, feed conversion ratio, total feed cost and feed cost/kg gain. Quails fed pearl millet based diets with or without enzyme supplementation have higher (P<0.05) total feed intake, average daily feed intake, feed conversion ratio, total feed cost and feed cost/kg gain compared to those fed the control (0% pearl millet). Growing Japanese quails fed pearl millet based diets with enzyme have similar (P>0.05) performance parameters with those fed the same diets without enzyme. Enzyme supplementation did not improve any of the performance parameters of growing Japanese quails fed pearl millet based diets. The results of this study show that enzyme supplementation in pearl millet based diets may not be necessary. This agrees with the findings of Arumbackam *et al.* (2004) that addition of feed enzymes to diets of growing Japanese quails did not improve growth performance, feed intake and feed efficiency.

Generally, improvements obtained by the supplementation of enzymes in poultry feeds are hinged on many factors, including the type and amount of cereal in the diet; the level of anti-

nutritional factors in the cereal (Munir and Maqsood, 2013). Hence, improvement expected and usually achieved with the use of currently available enzymes for wheat- or barley-based diets is higher, or at least more consistent, than may be obtained with the use of same enzymes for diets based on maize (Cowieson *et al*., 2006). Therefore, the pearl millet used in this study did not respond significantly to enzyme supplementation.

Since enzyme supplementation did not affect any of the performance parameters, the higher feed intake and feed conversion ratio of the pearl millet fed groups compared to the control may as well be attributed to the reduced energy and higher fibre content of the pearl millet based diets which resulted in increased feed intake as discussed earlier. The results of this study are in conformity with the observation of Udeybir *et al.* (2009) who observed no significant differences in feed intake and feed conversion ratio in the diets they fed PM to broilers with or without enzyme. On the contrary, Manwar and Mandal (2009) reported that the addition of enzymes to pearl-millet based diet improved the body weight gain of broiler chickens. Also Alam *et al.* (2003) reported that growth rate, feed intake, feed conversion were increased by addition of exogenous enzymes. Engberg *et al.* (2004) observed increased body weights of birds fed diets supplemented with xylanase compared with birds fed non-supplemented diets. There was no effect in body weight gain in male and female Japanese quail due to different dietary treatments and enzyme supplementation (Attia *et al.*, 2008).

Table 4: Main effect of Millet Form on the performance of growing Japanese quails

	Pearl Millet Form			
	Control	WPM	GPM	SEM*
Parameter				
Initial weight (g/bird)	35.47	35.98	34.91	1.11
Final Weight (g/bird)	129.49	138.64	134.56	2.86
Total weight gain (g/bird)	94.02	102.65	99.65	2.48
Average daily Weight gain (g/bird)	3.36	3.67	3.56	0.09
Total feed Intake (g/bird)	307.30^{b}	377.24^{a}	363.07^{a}	5.98
Average Daily feed intake (g/bird)	10.97^{b}	13.47^{a}	12.97^{a}	0.21
Feed Conversion ratio	3.27^{a}	3.69^{b}	3.65^{b}	0.06
Total Feed Cost (₦/bird)	29.45^{a}	37.65^{b}	37.04^{b}	0.65
Feed cost/kg gain (₦)	313.31^{a}	368.36^{b}	372.28^{b}	6.38
Age at first lay (days)	42.33	40.83	40.92	0.50
Weight at first lay (g/bird)	128.85	136.20	129.51	2.98
Weight of first egg (g)	7.33	7.67	7.58	0.23

$^{a, b, c}$ means in a row with no common superscript(s) differ significantly (P<0.05)

SEM – standard error of mean WPM: whole pearl millet GPM: ground pearl millet

* The SEM is for comparison between the 2 pearl millet forms. Comparison with the control was done using Dunnet's test

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

	ENZYME			
	Control	PM-EN	PM+EN	SEM*
PARAMETER				
Initial weight (g/bird)	35.47	35.69	35.20	1.11
Final weight (g/bird)	129.49	136.12	137.02	2.86
Total weight gain (g/bird)	94.02	100.48	101.82	2.48
Average daily weight gain (g/bird)	3.36	3.59	3.64	0.09
Total feed Intake (g/bird)	307.30[b]	367.09[a]	373.22[a]	5.98
Average daily feed intake (g/bird)	10.97[b]	13.11[a]	13.33[a]	0.21
Feed conversion ratio	3.27[a]	3.66[b]	3.68[b]	0.06
Total feed cost (₦/bird)	29.45[a]	36.92[b]	37.76[b]	0.65
Feed cost/kg gain (₦)	313.31[a]	368.47[b]	372.17[b]	6.38
Age at first lay (days)	42.33	40.67	41.08	0.50
Weight at first lay (g/bird)	128.85	133.83	131.88	2.98
Weight of first egg (g)	7.33	7.50	7.75	0.23

[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
* The SEM is for comparison between the 2 pearl millet based diets. Comparison with the control was done using Dunnet's test

CONCLUSION

From the results of this study, it can be concluded that pearl millet is a satisfactory cereal grain for the feeding growing Japanese quails. However, it increased feed cost. Grinding and enzyme supplementation of pearl millet based diets were not beneficial in the feeding of growing and laying Japanese quails. Where or when the price of millet of pearl millet is lower than that of maize, pearl millet can replace maize in the diets of growing Japanese quails. Whole pearl millet can be fed to Japanese quails. Enzyme supplementation might not be necessary when feeding pearl millet based diets.

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