Pearl Millet as an Alternative to Maize or Sorghum in the Diets of Broilers in Sokoto, Nigeria

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Abstract

The performance of broilers fed maize, sorghum or millet as sources of energy was studied for 8 weeks using two hundred and seventy six day-old chicks. The birds were randomly allocated to three treatment groups, each replicated four times such that each replicate had 23 chicks. The study was divided into two phases i.e. starter (0-4 weeks) and finisher (5-8 weeks). Three diets were formulated for each phase. Maize, sorghum or millet was used as the major source of energy in each of the three diets for each phase. Data on daily feed intake, weight gain and mortality were recorded. Feed conversion ratio was later calculated using feed intake and weight gain records. Results showed that at the starter phase, feed intake and weight gain of broilers fed pearl millet was significantly lower ($P<0.05$) than those fed maize or sorghum. Feed conversion ratio was also better ($P<0.05$) for broilers fed the two cereal grains compared to those fed pearl millet. At the finisher phase however, there was no significant difference ($P>0.05$) in all parameters monitored. This indicates that pearl millet may not particularly be as suitable as source of energy for broilers at the starter phase as maize or sorghum. It is however a good alternative to maize or sorghum for broilers in the finisher phase.

Keywords: Pearl millet, maize, corghum, broiler, diet

Introduction

The broiler chicken is an efficient converter of feed to meat, making it the major source of poultry meat for human consumption (Oluyemi and Roberts, 2000) to overcome the problem of low intake of animal protein among Nigerians (Komolafe *et al*., 1979). Animal protein is usually expensive due to the cost of feeding livestock and this call for research into more efficient use of available resources in boosting the performance and productivity of livestock to meet human animal protein needs at minimal cost (Anike and Okeke, 2003).

Although maize is the most widely used grain as source of energy in poultry feeds in Sokoto and its environs, it is not produced in large quantity by farmers in this area but brought from the neighbouring states of Niger, Katsina and Kaduna (Abubakar *et al*., 2006). Like maize, sorghum could be used as source of energy in broiler diets although its tannin content could be a limitation to its use especially in the diets of younger birds (Olomu, 1995).

Sokoto state is in the semi-arid ecological zone with little and erratic rainfall, which lasts for three to four months (June to September). The soil is sandy with characteristic low retention capacity as well as low organic matter. Pearl millet, a drought tolerant cereal crop is grown in large quantity in this area where the soil type, short and erratic rainy season do not fully support sorghum up to grain harvest.

Studies have shown that pearl millet is a promising crop for areas in

which drought, soil type and short rainy season diminishes the yield potential of sorghum. Pearl millet has metabolizable energy for non ruminants that equals that of maize (Abate and Gomez, 1984; Fancher *et al*., 1987; Amato and Forrester, 1995). When compared to maize on weight basis, millet is 60% higher in crude protein, 40% richer in lysine and methionine and 30% richer in threonine (Burton *et al*., 1972). Therefore, the use of pearl millet in broiler diets reduces the need for high protein feeding stuffs and supplemental amino acids. Studies by Hoseney *et al.* (1987), Rooney and McDonough (1987), Sullivan *et al.* (1990) and Bramel-Cox *et al*. (1995) showed that pearl millet is at least equivalent to maize and superior to sorghum in protein content and quality, protein efficiency (PER) values and metabolizable energy (ME) levels. Pearl millet does not contain condensed polyphenolic compounds such as tannins (as in sorghum) that can interfere with nutrient utilization.

According to Rooney and McDonough (1987) weight gain and feed/gain ratio obtained from birds fed pearl millet based diets were equal to those fed maize and sorghum. Smith *et al*. (1989) had earlier reported that pearl millet can replace sorghum in the diets for chickens without affecting weight gain and feed efficiency. This is because pearl millet grain has higher crude protein level by 1 and 2 percent relative to sorghum grown under similar cultural practices. Though deficient in some essential amino acids, it has 35% more lysine than sorghum (Rooney and McDonough, 1987). In addition, pearl millet grain has 5-6% oil and lower level of less digestible cross-linked prolamines (Jambunathan and Subramanian, 1988).

Differences in nutrients between millet and sorghum could be attributed partly to the kernel structure. The proportion of germ in pearl millet grain (17%) is about double that of sorghum, while the endosperm accounts for 75% of the grain as against 82% for sorghum grain. Pearl millet has high energy value because of its greater oil content. These potentials of millet make it a suitable feed ingredient for poultry in general.

Pearl millet is cheaper than maize or sorghum in Sokoto state since it is widely grown as staple food for peasant farmers and other categories of people. Presently, a bag (100kg) of pearl millet is sold for about N6000 compared to N8000 for maize or sorghum (Market Survey, 2009).

The aim of this study is to evaluate the performance of broilers (at starter and finisher phases) fed diets in which maize, sorghum or pearl millet served as major sources of energy. The objectives include comparing the feed intake, weight gain and feed conversion ratio of the birds fed the three cereal grains in order to assess the suitability of pearl millet compared to maize or sorghum in the study area.

Materials and Methods

Location of the experiment

The experiment was conducted in the poultry unit of the Department of Animal Science, Usmanu Danfodiyo University at the Sokoto State Veterinary Center along Aliyu Jodi Road in Sokoto metropolis. Sokoto is in the semi-arid ecological zone of North Western Nigeria.

The area has two major seasons: the long dry spell, which extends to June from October and the short rainy season, which begins from June to September. Mean annual rainfall ranges between 500 and 1300mm with mean annual temperature of 34.9°C (SERC, 2007).

Experimental layout

Two hundred and seventy-six day-old broiler chicks of the Ross strain were randomly allocated to three dietary treatment groups. Each treatment was replicated four times such that each replicate had 23 chicks. The birds were reared on deep litter and the study was conducted in two phases: starter (0-4weeks) and finisher (5-8 weeks). Routine medication and general maintenance practices were adhered to in accordance with the procedures of Oluyemi and Roberts (2000). Three diets were formulated to satisfy the nutrient requirements for each phase. Diets 1, 2 and 3 contained maize, sorghum or pearl millet respectively (Tables 1 and 2). At the finisher phase, the birds were re-randomized and distributed to the three treatment groups so that the replicates had similar initial body weight. Feed and water were offered *ad-libitum*. Feed intake was recorded daily while body weight was recorded on weekly basis to assess body weight changes. Records of feed intake and body weight gain were later used to calculate feed conversion ratio of the birds for each phase of the study.

Table 1: Gross composition (%) of experimental diets fed to broilers at starter phase (0-4 weeks)

Ingredient	Diet 1 (maize)	Diet 2 (sorghum)	Diet 3 (pearl millet)
Maize	52.30	-	-
Sorghum	-	52.30	-
Pearl millet	-	-	53.30
Groundnut cake	37.00	37.00	35.00
Wheat bran	5.00	5.00	6.00
Bone meal	3.00	3.00	3.00
Limestone	1.50	1.50	1.50
Vit./Min. premix*	0.30	0.30	0.30
Methionine	0.30	0.30	0.30
Lysine	0.30	0.30	0.30
Common salt	0.30	0.30	0.30
Total	**100**	**100**	**100**
Calculated analysis			
ME (kcal/kg)	2953.10	2953.10	2955.50
Crude protein (%)	23.33	23.85	23.76
Crude fibre (%)	3.30	3.30	3.50
Calcium (%)	1.72	1.90	1.70
Phosphorus (%)	0.85	1.10	1.10
Methionine (%)	0.60	0.50	0.60
Lysine (%)	1.20	1.20	1.24

*Vitamin A, 1000 IU; Vitamin D, 3000 IU; Vitamin E, 8.0 IU; Vitamin K, 2.0mg; Vitamin B1, 2.0mg; Vitamin B6, 1.2mg; Vitamin B12, 0.12mg; niacin, 1.0mg; Pantothenic acid, 7.0mg; Mg, 1000mg; Cu, 8.0mg; Co, 0.45mg and Se, 0.1mg per kg of diet.

Table 2: Gross composition (%) of experimental diets fed to finishers (5-8 weeks)

Ingredient	Diet 1 (maize)	Diet 2 (sorghum)	Diet 3 (pearl millet)
Maize	56	-	-
Sorghum	-	56.5	-
Pearl millet	-	-	57
Groundnut cake	27.95	26.45	25.45
Wheat bran	8.00	9.00	9.00
Bone meal	3.50	3.50	3.50
Limestone	1.50	1.50	1.50
Vit./Min. premix*	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Common salt	0.30	0.30	0.30
Palm oil	2.00	2.00	2.00
Total	**100**	**100**	**100**
Calculated analysis			
ME (kcal/kg)	3030	3022	3039
Crude protein (%)	20.13	20.39	20.39
Crude fibre (%)	3.2	3.2	6.5
Calcium (%)	1.9	2.4	2.06
Phosphorus (%)	0.65	0.80	0.60
Methionine (%)	0.52	0.50	0.52
Lysine (%)	0.90	1.00	1.00

*Vitamin A, 1000 IU; Vitamin D, 3000 IU; Vitamin E, 8.0 IU; Vitamin K, 2.0mg; Vitamin B1, 2.0mg; Vitamin B6, 1.2mg; Vitamin B12, 0.12mg; niacin, 1.0mg; Pantothenic acid, 7.0mg; Mg, 1000mg; Cu, 8.0mg; Co, 0.45mg and Se, 0.1mg per kg of diet.

Statistical analysis

Data collected were subjected to analysis of variance in a completely randomized design. Means were compared using Least Significance Difference (LSD). The analysis was carried out using the general linear model programme of the Statistical Package for Social Sciences (SPSS, 1999).

Results and Discussion

Performance of broilers at the starter phase

The performance characteristics of broiler starters fed pearl millet as alternative to maize or sorghum as source of energy at the starter phase (0-4 weeks of age) are shown in table 3. Broiler starters fed pearl millet consumed significantly lesser ($P<0.05$) feed (45.26 g/b/d) compared to those fed maize (47.18 g/b/d) and sorghum (47.49 g/b/d), which had similar feed intake values. This result disagreed with the report of Abubakar *et al*. (2006) which stated that there was no significant difference in

performance parameters (including feed intake) between broiler starters fed pearl millet or maize as source of energy. Again, the low feed intake of broiler starters fed pearl millet in this study was contrary to the views of Hosney *et al.* (1987) and Rooney *et al*. (1987) that pearl millet is at least equivalent to maize and generally superior to sorghum in quality.

Body weight gain of broiler starters fed pearl millet (427.53 g/b) reflected the low feed intake because it was significantly inferior (P<0.05) to body weight gain of those fed maize (531.76 g/b) or sorghum (523.75 g/b). Under normal conditions birds of the same breed and strain that consume more feed are supposed to have higher body weight gain (Olomu, 1995) provided the feeds have similar nutrient content.

Table 3: Performance characteristics of broiler starters

Parameter	Diet 1 (maize)	Diet 2 (sorghum)	Diet 3 (pearl millet)	SEM ±
Feed intake (g/b/d)	47.18[a]	47.49[a]	45.26[b]	0.624
Initial body weight (g/b)	55.45	57.74	56.55	1.510
Final body weight (g/b)	587.76[a]	581.49[a]	484.08[b]	12.621
Body weight gain (g/b)	531.76[a]	523.75[a]	427.53[b]	12.893
Feed conversion ratio	2.49[b]	2.54[b]	2.98[a]	0.069
Mortality (%)	0	1.19	3.57	

a,b,c: Means with different letters along the same row are significantly different (P<0.05)

Similarly, feed conversion ratio of broiler starters fed maize (2.49) or sorghum (2.54) were significantly better (P<0.05) than those fed millet (2.98) as source of energy. In addition to their high feed intake, starters fed maize or sorghum utilized the feed consumed better for gain. Mortality recorded during the starter experiment was generally low (0, 2 and 4% for maize, sorghum and pearl millet, respectively) and below the 5% allowance for broilers (Oluyemi and Roberts, 2000). This low mortality indicated that the three cereal grains are safe for use as energy sources. It further confirms the reports of Sullivan *et al.* (1990) and Bramel-Cox *et al*. (1995) that pearl millet does not contain polyphenolic compounds that can cause mortality in younger birds due to toxicity.

Performance characteristics of broiler finishers

The performance of broiler finishers fed pearl millet as an alternative to maize or sorghum as source of energy is shown in table 4. There was no significant difference (P>0.05) between treatments in all parameters monitored. Feed intake was 132.72, 134.11 and 132.80 g/b/d for finishers fed maze, sorghum or millet, respectively. This could be due to the ability of the birds to thrive under wide range of dietary energy content by adjusting their feed intake to meet their energy requirement. At the finisher phase the birds had accelerated growth rate and so consumed more feed for that purpose (Oluyemi and Roberts, 2000). Values obtained for feed intake were lower than the values (162.50 g/b/d) obtained by

Iyayi and Bashar, (1999) but higher than those (120.59, 114-118 and 128.69 g/b/d) reported by Awojobi *et al.* (1999), Nworgu and Egbunike (1999) and Abubakar *et al.* (2006) respectively.

Table 4: Performance of broiler finishers fed different energy sources

Parameter	Diet 1 (maize)	Diet 2 (sorghum)	Diet 3 (pearl millet)	SEM ±
Feed intake (g/b/d)	135.72	134.11	132.80	3.266
Initial body weight (g/b)	644.97	639.66	633.49	8.935
Final body weight (g/b)	1967.52	1826.52	1896.93	42.930
Body weight gain (g/b)	1279.55	1186.86	1262.99	37.587
Feed conversion ratio	2.97	3.18	2.94	0.125
Mortality (%)	2.97	2.90	4.35	1.881

Body weight gain of finishers fed maize was 1279.52 g/b, those fed sorghum had 1186.86 g/b while 1262.99 g/b was for those fed pearl millet. Body weight gain followed the pattern of feed intake, which did not show any significant difference ($P>0.05$) between the treatments. Body weight gain values obtained in this study were higher than those (880 and1092 g/b) reported by Iyayi and Bashar (1999) and Awojobi *et al.* (1999) but slightly lower than 1495 g/b reported by Nworgu and Egbunike (1999).

Feed/gain ratio was similar across treatments. Finishers fed maize based diet had 2.94, those on sorghum based diet had 2.97 while those fed the pearl millet diet converted 3.18 part of feed to 1 part of gain. These values agreed with the values (2.99) reported by Abubakar *et al.* (2006) and 3.11 reported by Awojobi *et al*. (1999) Mortality was generally below 5% and can therefore not be ascribed to the test ingredients but due to chance (Oluyemi and Roberts, 2000).

Conclusion

Despite the difference in performance of broilers fed pearl millet diet at the starter phase, the test ingredient could be considered a suitable alternative to maize or sorghum for broiler farmers in Sokoto and its environs. This is because at the finisher phase, the birds fed pearl millet based diets compared favourably in all performance parameters to those fed maize or sorghum diets. Broiler farmers in the study area could exploit pearl millet to their advantage since it is more readily available compared to maize or sorghum.

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