Growth Performance and Economic Analysis of Weaner Pigs Fed Millet Hulls Supplemented with Enzyme

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ABSTRACT

This study evaluated the growth performance and assessed the economic viability of producing weaned pigs fed millet hulls supplemented with Quadraxyme. Eighteen (18) mixed-sex local breeds of weaned pigs, with an average weight of 7.00 kg, were randomly assigned to three groups of six animals each. Each group was replicated three times in a completely randomized design. The pigs were fed *ad libitum*, and the experiment lasted 56 days. Data were collected on initial and final body weights, daily feed intake, and feed conversion ratios (FCR). The growth performance results showed that pigs fed 100% millet hulls supplemented with 0.2 kg/100 kg enzyme had the highest average daily feed intake (0.50 kg), compared to those on the control diet (0.45 kg). Pigs fed 50% millet hulls had the lowest average daily feed intake (0.39 kg). The study revealed that f millet hulls in the diet increased and total feed intake, resulting in higher body weight gains in the pigs. Diets containing 50% millet hulls and 50% maize showed the lowest FCR, indicating improved feed efficiency. Economically, the cost of producing feed with millet hulls was lower than maize-based feed. Based on the findings, it was recommended that millet hulls could be used as an alternative fibre source in the diet of weaned pigs, up to 100% supplementation with enzymes, without any adverse effects on growth performance

Keywords: Growth. Hulls, Millets, weaned pigs,

INTRODUCTION

The rising cost of conventional energy feed ingredients has driven extensive research into more affordable, alternative energy sources from unconventional feed resources [1, 2]. The volume of agricultural residue produced is directly proportional to the primary crop yield and can be estimated using the residue-to-product ratio (RPR). In Nigeria, the RPR values for crops such as cassava, groundnut, sorghum, millet, maize, cowpea, plantain, and palm kernels are 2.0, 2.3, 1.25, 1.75, 4.328, 1.75, 0.50, and 0.25, respectively [3]. These residues have been identified as valuable feedstock for animal production.

Millet refers to a group of small-seeded annual grass grains, widely grown in Nigeria, contributing approximately 40% of Africa's millet production (4.53 million tons), with over 80% produced in the northern region [4]. Nigeria is the world's second-largest millet producer in 2020, two million metric tons of millet were produced, yielding significant millet hulls as a by-product after harvest [5].

Millet hulls, the scaly protective casings of millet, are indigestible for humans but serve as livestock fodder or agricultural residue ploughed into the soil or burned. The hulls are usually removed through a decortication process involving washing, crushing, and winnowing, after which they are often discarded or burned in fields [6]

Pig production in Nigeria faces challenges due to the high cost of inputs, particularly feed, which accounts for 70–85% of total production costs [7]. Pig performance, including weight gain, feeding efficiency, and carcass

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quality, is closely linked to nutrient intake, especially energy and protein [8]. Although industrial by-products such as millet hulls, cassava peels, palm kernel meals, brewer's spent grains, and wheat offal are recognized as potential alternative feed sources, their use remains underutilized.

Millet hulls consist of complex carbohydrates that require degradation into simple sugars to enhance their energy value, necessitating adding exogenous enzymes to the feed [9]. Enzymes have been used in livestock production for over two decades, particularly in diets containing high soluble non-starch polysaccharides (NSPs) in grains like wheat, oats, barley, and rye [10]. In recent years, enzymes have also been applied to corn-based diets for both poultry and pigs. While NSP-degrading enzymes have demonstrated clear benefits in poultry-fed NSP-rich diets [11], the results are less consistent in pigs [12, 13]. This study evaluated the effects of supplementing millet hulls with enzymes on raising weaned pigs' growth performance and economic feasibility

MATERIALS AND METHODS

Study area

The study was conducted at the Swine Unit of the Teaching and Research Farm, Department of Animal Production and Health, Federal University Wukari, Taraba State. Nigeria. Wukari is located at a longitude of 9°47'0" E and latitude of 7°51'0" N. The region's vegetation is predominantly characteristic of the savanna zone, with two major climatic seasons: the wet or rainy season, which begins in March or April and ends in October, and the dry season, which starts in November and lasts until March or April [14].

Source of millet hulls

Millet hulls were sourced from the cereals processing centre in Wukari. The hulls were screened of stones and specks of dirt to avoid contamination.

Experimental Design and Animal Management

Eighteen (18) mixed local breeds of weaner pigs with an average weight of 7.00kg were sourced within Wukari metropolis. The pigs were divided into three groups of six animals per group, replicated three times in a completely randomized design. Each pen was provided with feeders, drinkers and wallows. The animals were dewormed before the commencement of the experiment. The animals were fed ad libitum and the experiment lasted for 56 day

Data collection

Growth performance evaluation

Feed consumption was monitored throughout the study. To track growth, the pig was initially weighed upon arrival and then weighed weekly thereafter. Body weight gain and total live weight gain were calculated at the end of the experiment. Weight gain and feed consumption data were used to compute the feed conversion rate (FCR).

Economics of production

After the study, the feed cost per kilogram was calculated based on the prevailing market price of ingredients, including processing costs to make a 100kg diet, then divided by 100. The total cost of feed intake was determined by multiplying the total feed intake for each treatment by the cost per kilogram of feed. The feed cost per kilogram of gain was calculated by dividing the total feed intake cost by the total weight gain.

Statistical analysis

The data collected were analyzed using Analysis of Variance (ANOVA) using [15]. Significant differences among treatment means were separated using the same statistical tools.

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Experimental Diets

Three dietary treatments were compounded using millet hulls. Diet 1 served as a control containing 100% maize, while Diet 2 contained 50% maize offal and 50% millet hulls, and Diet 3 contained 100% millet hulls inclusion levels, respectively. The diets were supplemented with 0.2 kg /kg of quadraxyme (Table 1).

Table 1 Ingredients and composition of experimental Diets

Ingredients	T1	T2	T3
Maize	48.00	48.00	48.00
Kapok cake	5.00	5.00	5.00
Soyabean meal	20.00	20.00	20.00
Maize offals	25.00	12.50	0.00
Millet hulls	0.00	12.50	25.00
Bone meal	1.00	1.00	1.00
Methionine	0.30	0.30	0.30
Lysine	0.20	0.20	0.20
Premix	0.20	0.20	0.20
Salt	0.30	0.30	0.30
Enzyme*	+	+	+
Total *Calculated analysis*	**100.00**	**100.00**	**100.00**
Crude protein	17.87	17.06	17.08
Crude fibre	10.78	11.56	12.67
Energy kcal ME/kg	3001.34	3001.56	3001.78

Tl= Control 100% Maize, T2 =50% millet hulls, T3 = 100% millet hulls

*premix composition (per kg of diet): vitamin A, 12500 IU; vitamin D_3, 2500 IU; vitamin E, 50.00 mg; vitamin K_3, 2.50 mg; vitamin B_1, 3.00 mg; vitamin B_2, 6.00 mg; vitamin B_6, 6.00 mg; niacin, 40 mg; calcium pantothenic, 10 mg; biotin, 0.08 mg; vitamin B_{12}, 0.25 mg; folic acid, 1.00 mg; chlorine chloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; and antioxidant, 200 mg

Enzyme composition per kg diet: amylase 110,000units, cellulose 500,000.00units, xylanase 1,000,000units, lipase 10,000units, pactinase 30,000.0units and 4,000 units

RESULTS AND DISCUSSION

Performance of growing pigs fed millet hulls supplemented with enzyme

The performance of growing pigs fed millet hulls supplemented with 0.2 kg/100 kg Quadraxyme is summarized in Table 2. The results indicate that pigs fed 100% millet hulls with enzyme supplementation had the highest average daily feed intake (0.50 kg), compared to those on the control diet (0.45 kg). Pigs fed 50% millet hulls had the lowest average daily feed intake (0.39 kg). Enzymes are rich sources of high-quality protein, amino acids (such as lysine), and vitamins, contributing to their growth-promoting properties [16].

The average total feed intake ranged from 25.60 kg in pigs on the control diet to 28.16 kg in pigs fed 100% millet hulls supplemented with 0.2 kg/100 kg Quadraxyme. The lowest value (22.23 kg) was observed in pigs fed 50% millet hulls. These differences were statistically significant ($P<0.05$) across the treatment groups. The observed variations in feed intake suggest that the diets were palatable, as the pigs ate to meet their energy requirements. Enzyme supplementation likely enhanced the degradation of complex carbohydrates into simple sugars, increasing the energy value of the millet hulls [17].

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The results of this study differ from the findings by [18 and 19], who reported no significant differences in daily feed intake for poultry and pigs fed enzyme-supplemented diets.

The average final body weight of the pigs ranged from 17.60 kg for those on the control diet to 19.26 kg for pigs fed 100% millet hulls supplemented with 0.2 kg/100 kg Quadraxyme. Average total body weight gain ranged from 9.16 kg (control) to 11.08 kg (100% millet hull with enzyme supplementation). These values were statistically significant (P<0.05) across the treatment groups, with enzyme supplementation increasing body weight gain. Average daily weight gain was lowest (0.16 kg) in pigs on the control diet and highest (0.198 kg) in pigs fed 100% millet hulls with enzyme supplementation. The improved weight gains can be attributed to enhanced utilization of the fibrous diet due to enzyme activity. These results are consistent with those reported by [20] for pigs fed rough rice-based diets with or without non-starch polysaccharide (NSP) enzymes, and cassava peel-based diets supplemented with enzymes.

The feed conversion ratio (FCR) improved significantly (P<0.05) across the treatment groups, decreasing from 2.85 in pigs on the control diet to 2.59 in those fed 100% millet hulls with enzyme supplementation. The lowest FCR value (2.24) was observed in pigs fed 50% millet hulls. These values, however, were higher than those reported by [21] for pigs fed diets supplemented with 1.5 g/kg and 2 g/kg of enzymes (1.90 and 1.83, respectively). Similarly, Oluwafemi and Ikchukwu [23] reported lower FCR values for pigs fed cassava peel meal diets with various enzyme levels. The improved FCR in pigs fed enzyme-supplemented diets may result from the action of enzymes like xylanase and β-glucanase in breaking down cell wall fractions in millet hulls [9].

Table 2 Growth performance of weaner pigs fed enzyme supplemented diets

Dietary treatments					
Parameter	T1	T2	T3	SEM	P-value
Initial body weight (kg)	8.43	8.69	8.18	0.33	0.68
Final body weight (kg)	17.60^{b}	18.50^{ab}	19.26^{a}	0.68	0.02
Total body weight gain (kg)	9.16^{b}	9.90^{ab}	11.08^{a}	0.85	0.03
Total feed intake (kg)	25.60^{a}	22.23^{b}	28.16^{a}	0.99	0.01
Average Daily feed intake (kg)	0.45^{ab}	0.39^{b}	0.50^{a}	0.02	0.01
Average Daily weight gain	0.16	0.17	0.19	0.02	0.34
Feed conversion ratio	2.85	2.24	2.59	0.25	0.28

Tl= Control 100% Maize, T2 =50% millet hulls, T3 = 100% millet hulls

Means with different superscript on the same row are significantly differ (P<0.05) SEM: Standard error of mean

Economics of producing weaner pigs

The economic analysis of growing pigs fed millet hulls supplemented with 0.2 kg/100 kg Quadraxyme is presented in Table 3. Including millet hulls at a 50% replacement level significantly (P<0.05) reduced the cost of producing a kilogram of feed from ₦249.36 to ₦236.86. Furthermore, diets containing 100% millet hulls led to an even greater reduction in feed cost per kilogram. This significant decrease in feed cost, attributed to the inclusion of millet hulls and enzyme supplementation, indicates that pig farmers can maintain profitability even when maize offal becomes unaffordable. The feed cost consumed by pigs on millet hull based diets was significantly lower (P<0.05) than the control group. For pigs fed the T2 diet, feed costs decreased to ₦6,320.10, while those on the T3 diet had feed costs reduced to ₦5,261.70. Regarding feed cost per weight gain, the control diet recorded ₦707.99, while pigs fed the T2 diet achieved a lower cost of ₦583.37 per weight gain. These results demonstrate a relative reduction in production costs with enzyme supplementation. Producing a kilogram of weight gain was more cost-effective when millet hulls supplemented with enzymes were included in the diet.

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Table 3 Economics of producing weaner pigs fed enzyme supplemented diets

	Dietary treatments				
Parameter	T1	T2	T3	SEM	P-value
Cost of feed per Kg(₦/kg)	249.36[b]	236.86[b]	224.36[c]	3.19	0.04
Cost of feed consumed (₦)	6380.20[a]	6320.10[a]	5261.70[b]	21.89	0.01
Cost of Feed/weight gain (₦)	707.99[a]	583.77[b]	531.32[b]	3.45	0.03

Tl= Control 100% Maize, T2 =50% millet hulls, T3 = 100% millet hulls

Means with different superscript on the same row are significantly differ (P<0.05)

SEM: Standard error of mean

CONCLUSION

Based on the findings of this study, millet hulls can serve as an alternative fibre source in weaner pig diets and can be included at up to 100% without adversely affecting growth performance or production costs. Additionally, the supplementation of millet hulls with Quadraxyme is recommended for optimal results

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