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GROWTH PERFORMANCE AND CARCASS TRAITS OF BROILER CHICKENS FED RICE OFFAL-BASED DIETS SUPPLEMENTED WITH XYLANASE AND GLUCANASE

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Abstract
This study evaluated the effects of xylanase and glucanase supplementation on growth performance and carcass traits of broiler chickens fed rice offal (RO)-based diets. A total of 180 unsexed day-old broiler chicks were randomly allocated to four dietary treatments in a completely randomized design, with three replicates of 15 birds each. The control diet contained no RO or enzyme supplementation, while the other treatments contained 5%, 10%, or 15% RO, each supplemented with a 50:50 combination of xylanase and glucanase at manufacturer-recommended levels. Growth performance was assessed during the starter (0–4 weeks) and finisher (5–8 weeks) phases, while carcass characteristics were determined at the end of the finisher phase. Results showed that during the starter phase, birds on 10RO and 15RO diets had significantly higher ($p < 0.05$) average daily weight gain (32.21 g and 32.46 g, respectively) compared to the control, while feed conversion ratio (FCR) was lowest in the 5RO group (1.43). In the finisher phase, birds on the 10RO diet recorded the highest ($p < 0.05$) weight gain (34.75 g), feed intake (119.74 g), and FCR (3.50). Carcass traits at the finisher phase indicated that 10RO produced the highest ($p < 0.05$) live weight (1,555.90 g) and dressed weight (1,083.30 g), whereas 15RO yielded the highest dressing percentage (72.20%). The study concludes that inclusion of up to 10% RO with xylanase and glucanase supplementation optimizes growth and carcass yield in broiler chickens.

Keywords: Broiler chickens, rice offal, xylanase, glucanase, growth performance, carcass traits.

Introduction

Feed costs constitute the largest single input in poultry production, accounting for 70–80% of the total production cost in most developing countries (Afolayan *et al*., 2019). In Nigeria, the high cost of conventional feed ingredients such as maize and soybean meal is exacerbated by competition between humans and livestock, seasonal fluctuations in supply, and increasing demand due to a growing population (FAO, 2022; Olawoye *et al*., 2021). This situation has led researchers to explore alternative, locally available feed resources that can partially replace costly conventional ingredients without compromising productivity (Esonu *et al*., 2018).

Rice offal (RO), a by-product of rice milling, is abundantly available in rice-producing areas of Nigeria and other tropical countries. It consists mainly of the husk, bran, and small amounts of broken rice, and is rich in fibre but low in metabolizable energy and protein (Ojewola *et al*., 2020). Despite these limitations, RO is a promising feed ingredient for poultry due to its low cost and year-round availability (Onyimonyi and Okeke, 2021). However, its high content of non-starch polysaccharides (NSP) and

lignin reduces digestibility, nutrient absorption, and overall feed efficiency (Akinola *et al*., 2017; Oluwatosin *et al*., 2019).

Enzyme supplementation has been identified as an effective strategy to improve the nutritive value of high-fibre feed ingredients. Xylanase and glucanase degrade NSP components such as arabinoxylans and β-glucans, thereby reducing intestinal viscosity and enhancing nutrient release (Adeola and Cowieson, 2011; Choct, 2015). Previous studies have demonstrated that incorporating exogenous fibrolytic enzymes into poultry diets containing fibrous agro-industrial by-products improves growth performance, feed conversion ratio, and carcass yield (Olukosi *et al*., 2020; Tiwari *et al*., 2021).

While studies have evaluated the inclusion of rice milling by-products in poultry diets, limited research has investigated the combined use of xylanase and glucanase in RO-based diets for broilers. This study therefore aimed to assess the effects of varying inclusion levels of RO supplemented with xylanase and glucanase on growth performance during the starter and finisher phases, as well as carcass characteristics at the finisher stage.

Materials and Methods

Study location

This study was conducted at the Poultry Unit, Adamawa State University Teaching and Research Farm (Gidan-madara), Sahuda road, Mubi South Local Government Area (LGA), Adamawa State. The dry season of the area commences in November and ends in March, while the wet season begins from April and ends in late October. The mean annual rainfall is about 1050 mm. The relative humidity is extremely low (20-30%) between January and March but reaches a peak of about 80% in August and September. The maximum temperature can reach 40°C particularly in April while the minimum temperature is about 12°C between December and January (Weather Station, 2022).

Sources of Experimental feed ingredients

The RO was sourced from local rice mill along Maiha road, Mubi LGA. It was cleaned of foreign materials, separated and bagged until it was time for mixing the experimental feed. The enzymes (xylanase and glucanase) were purchased from RONOZYME® MultiGrain (MG), DSM Nutritional Products Ltd, Switzerland; xylanase (endo-1, 4-β-xylanase; EC 3.2.1.8) and glucanase (endo-1, 3 (4)-β-glucanase; EC 3.2.1.6. and endo-1, 4-β-glucanase: EC 3.2.1.4). The enzymes were included at manufacturer's recommendations (100 g of enzyme/100 kg of feed). The macro ingredients includes soybean meal, groundnut meal, maize, maize offal. They were purchased from reputable sources from various markets here in Mubi. The micro ingredients that were used includes bone ash, vitamin/mineral premix, methionine, lysine and common salt which were purchased from a reputable livestock store in Yola.

Preparation of Experimental Diets

Four experimental diets were formulated to meet the recommended dietary allowance of the broiler birds according to (NRC, 2018). One of the diets excludes the RO and enzymes, which served as the control. The other dietary treatments received same levels of xylanase and glucanase combination at 50:50 ratio. The RO was included at three level namely: 5%, 10% and 15% w/w denoted as 5RO, 10RO and 15RO, respectively. This was same for both starter and finisher phases.

Experimental Animals, Design and Management

A total of 180 unsexed day-old broiler chicks were allotted to four dietary treatments in a completely randomized design, with three replicates of 15 birds each. The control diet contained no rice offal (RO) or enzyme supplementation, while other diets contained 5%, 10%, or 15% RO, each supplemented with a 50:50 blend of xylanase and glucanase at manufacturer-recommended levels. The feeding trial lasted for eight weeks, divided into starter (0–4 weeks) and finisher (5–8 weeks) phases.

Table 1: Gross composition (%) of broiler starter diets containing rice offal supplemented with xylanase-glucanase combination

Ingredients	**Control**	**5RO**	**10RO**	**15RO**
Maize	35.79	32.71	29.63	26.5
Maize offal	17.90	16.35	14.82	13.28
Rice offal	0.00	5.00	10.00	15.00
Groundnut cake	21.16	20.97	20.78	20.59
Full fat soybean	21.16	20.97	20.78	20.59
Bone meal	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Calculated analysis				
ME (kcal/kg)	2933.40	2918.77	2900.28	2893.19
Crude Protein	23.29	23.15	23.26	23.11
Crude fibre	5.08	5.44	5.80	6.20
Calcium	1.10	1.10	1.10	1.10
Phosphorus	0.35	0.37	0.38	0.38
Methionine	0.57	0.57	0.58	0.56
Lysine	1.22	1.21	1.18	1.23

5RO, 10RO and 15RO: 5%, 10% and 15% levels of inclusion of rice offal, ME: metabolizable energy

Table 2: Gross composition (%) of the broiler finisher diets containing rice offal supplemented with xylanase-glucanase combination

Ingredients	**Control**	**5RO**	**10RO**	**15RO**
Maize	52.67	48.00	43.58	38.7
Maize offal	10.00	10.00	10.00	10.00
Rice offal	0.00	5.00	10.00	15.00
Full fat soybean	22.30	22.10	20.90	21.60
Groundnut cake	11.15	11.05	10.45	10.80
Bone meal	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Calculated analysis				
ME (Kcal/kg)	3062.15	3022.11	3001.21	2998.11
Crude Protein	20.12	20.10	20.03	20.01
Crude Fibre	4.04	4.55	5.00	6.30

Calcium	1.10	1.10	1.10	1.10
Phosphorus	0.65	0.72	0.75	0.76
Methionine	0.57	0.54	0.54	0.56
Lysine	1.02	1.02	1.09	1.19

5RO, 10RO and 15RO: 5%, 10% and 15% levels of inclusion of rice offal, ME: metabolizable energy

Data collection

Growth performance parameters measured included initial and final body weight, average daily weight gain (ADWG), average daily feed intake (ADFI), and feed conversion ratio (FCR). Carcass traits were measured at the end of the finisher phase on three birds per replicate.

Statistical analysis

Data collected were analyzed using GLM procedure of IBM SPSS software version 23 (2015). The treatment effects were tested at 95% significant level (p0.05) and significant differences between treatment means were established by Dunnett's Test.

Results and Discussion

The results of the growth performance for both the starter and finisher phases, as well as carcass characteristics of broilers fed rice offal (RO)–based diets supplemented with a xylanase–glucanase enzyme complex, are presented in Tables 3–5.

Table 3: Growth performance(g) of broiler starter fed diets containing rice offal supplemented with xylanase-glucanase combination

Parameter	**Control**	**5RO**	**10RO**	**15RO**	**SEM**
Initial weight (g)	43.00	43.00	43.00	43.00	0.13
Final weight (g)	912.33^{c}	938.00^{b}	945.00^{a}	952.00^{a}	13.74
ADWG (g)	31.04^{c}	31.05^{c}	32.21^{a}	32.46^{a}	0.14
ADFI (g)	44.67^{d}	45.76^{c}	47.11^{b}	47.55^{a}	0.16
FCR	1.44^{a}	1.43^{a}	1.46^{b}	1.46^{b}	0.03

Table 4: Growth performance(g) of broiler finisher fed diets containing rice offal supplemented with xylanase-glucanase combination

Parameter	**Control**	**5RO**	**10RO**	**15RO**	**SEM**
Final weight (g)	1520.60^{c}	1539.80^{b}	1555.90^{a}	1552.30^{a}	12.24
ADWG (g)	32.40^{c}	33.10^{b}	34.75^{a}	34.20^{a}	0.18
ADFI (g)	114.00^{c}	116.50^{b}	119.74^{a}	119.20^{a}	0.24
FCR	3.52^{b}	3.52^{b}	3.50^{a}	3.53^{b}	0.02

Table 5: Carcase characteristics of broiler finisher fed diets containing rice offal supplemented with xylanase-glucanase combination

Parameter	Control	10RO	15RO	SEM
Live weight (g)	1520.60[c]	1555.90[a]	1552.30[a]	12.24
Dressed weight (g)	1066.7[c]	1083.3[a]	1078.0[b]	8.43
Dressing percentage (%)	70.10[b]	69.60[b]	72.20[a]	0.25

Growth Performance (Starter Phase)

Broilers fed RO-based diets supplemented with xylanase–glucanase showed clear improvements in performance indices compared to the control (Table 3). All treatments began with the same initial weight of 43 g, indicating uniformity at baseline. However, substantial differences were observed in final weight, ADWG, ADFI, and FCR.

The 10RO and 15RO diets produced the highest final weights (945.00 g and 952.00 g, respectively), significantly higher than the control (912.33 g) and 5RO (938.00 g). Similarly, ADWG followed the same trend, with the 10RO and 15RO treatments achieving 32.21 g and 32.46 per day, compared to 31.04 g in the control.

Feed intake (ADFI) also increased progressively with RO inclusion: birds on 15RO consumed 47.55 g/day, followed by 10RO (47.11 g/day) and 5RO (45.76 g/day)**,** all significantly higher than the control (44.67 g/day)**.** This indicates that enzyme-treated diets may have enhanced palatability or improved gut environment, encouraging feed consumption.

Despite higher intake, feed conversion ratio remained efficient. Although the 10RO and 15RO groups recorded FCR values of 1.46, these were comparable to the control (1.44) and 5RO (1.43), indicating efficient feed utilization at higher RO inclusion levels. These outcomes support earlier studies by Olukosi et al. (2020) and Adeola & Cowieson (2011), who demonstrated that xylanase and glucanase reduce digesta viscosity and improve nutrient digestibility in NSP-rich diets. The improved performance in the starter phase suggests enhanced energy and nutrient release from RO, facilitating better early growth.

Growth Performance (Finisher Phase)

In the finisher period (Table 4), birds on the 10RO diet continued to outperform other treatments. The 10RO group recorded the highest final weight (1555.90 g) and the greatest ADWG (34.75 g/day), followed closely by 15RO (34.20 g/day) and 5RO (33.10 g/day)**,** with the control recording the lowest (32.40 g/day).

Feed intake reflected similar improvements, with 10RO and 15RO consuming 119.74 g/day and 119.20 g/day, respectively, compared to 114.00 g/day in the control.

The best FCR was observed in the 10RO group (3.50), slightly better than the control (3.52), 5RO (3.52), and 15RO (3.53). The 15RO response suggests that although enzyme supplementation improves RO utilization, very high fibre levels may slightly reduce digestive efficiency in older birds. However, both 10RO and 15RO still performed better than the control overall. These results align with Tiwari et al. (2021) and Afolayan et al. (2019), who reported that moderate inclusion of agro-industrial by-products with exogenous enzymes enhances nutrient uptake, gut function, and overall growth performance in broilers.

Carcass Characteristics

Carcass traits (Table 5) showed that birds fed the 10RO diet achieved the highest live weight **(**1555.90 g) and dressed weight **(**1083.3g**),** indicating superior nutrient conversion into lean tissue. The 15RO group, however, recorded the highest dressing percentage (72.20**%**), higher than both the control (70.10%) and 10RO (69.60%)**.**

This suggests that although 10RO promoted the greatest body and muscle mass, the 15RO diet

produced proportionally better carcass yield relative to body size. These enhancements across enzyme-supplemented diets are consistent with findings by Esonu et al. (2018) and Onyimonyi & Okeke (2021), who reported improved muscle deposition and carcass quality in broilers fed enzyme-treated high-fibre diets. Overall, inclusion of RO up to 10**%**, when supplemented with a xylanase–glucanase enzyme complex, produced the most favorable outcomes in terms of growth rate, feed intake, feed efficiency, and carcass yield. The improvement observed reflects the synergistic action between RO fibre components and the targeted enzymes that enhance polysaccharide degradation and nutrient availability.

These results corroborate the conclusions of Olawoye et al. (2021) and Ojewola et al. (2020), who emphasized that enzyme technology improves nutrient utilization in fibre-rich feed ingredients, enhances feed efficiency, and broadens the economic use of unconventional feedstuffs in poultry production.

Thus, the study reinforces the practical value of incorporating enzyme complexes into fibre-rich diets such as rice offal to optimize broiler performance without compromising carcass characteristics.

Conclusion

This study demonstrated that the inclusion of rice offal (RO) in broiler diets, when supplemented with a 50:50 combination of xylanase and glucanase, can effectively improve growth performance and carcass characteristics. The results indicate that birds fed diets containing 10% RO with enzyme supplementation achieved the highest average daily weight gain, optimal feed conversion efficiency, and superior carcass yield compared to the control and other treatment groups. The enhancement in performance can be attributed to the ability of the enzymes to degrade non-starch polysaccharides, thereby reducing intestinal viscosity, increasing nutrient release, and improving digestibility of fibre-rich feed ingredients.

The study also revealed that higher inclusion levels (up to 15% RO) can maintain acceptable growth and even enhance dressing percentage, although performance benefits may peak at moderate inclusion levels. From a practical standpoint, the findings highlight that RO, a low-cost and locally available agro-industrial by-product, can partially replace conventional feed ingredients without compromising productivity when properly supplemented with fibrolytic enzymes. This offers a sustainable and economically viable approach to reducing feed costs in poultry production, particularly in resource-limited settings.

It is therefore recommended that poultry producers consider incorporating up to 10% RO in broiler diets with appropriate xylanase and glucanase supplementation. Further studies could explore the long-term effects of RO-based diets on meat quality, nutrient retention, and overall economic returns under commercial production conditions.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

References

Adeola, O.,and Cowieson, A. J. (2011). Board-invited review: Opportunities and challenges in using exogenous enzymes to improve nonruminant animal production. *Journal*

of Animal Science, 89(10), 3189–3218. https://doi.org/10.2527/jas.2010-3715

Afolayan, S. B., Akinola, L. A. F.,and Aderemi, F. A. (2019). Performance and nutrient digestibility of broilers fed diets containing agro-industrial by-products supplemented with enzymes. *Nigerian Journal of Animal Production, 46*(2), 45–55.

Akinola, L. A. F., Oloruntola, O. D.,and Agboola, A. F. (2017). Effects of dietary inclusion of rice milling waste on performance and nutrient digestibility of broiler chickens. *Tropical Animal Health and Production, 49*(7), 1345–1351. https://doi.org/10.1007/s11250-017-1339-7

Choct, M. (2015). Feed non-starch polysaccharides and their impact on poultry nutrition. *World's Poultry Science Journal, 71*(2), 299–309. https://doi.org/10.1017/S0043933915000124

Esonu, B. O., Nworgu, F. C.,and Obike, O. M. (2018). Effect of enzyme supplementation on the performance of broilers fed rice milling by-products. *Journal of Animal Production Research, 30*(1), 73–81.

FAO. (2022). *The state of food security and nutrition in the world 2022: Repurposing food and agricultural policies to make healthy diets more affordable*. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cc0639en

NRC. (2018). *Nutrient requirements of poultry* (10th rev. ed.). National Academies Press. https://doi.org/10.17226/24998

Ojewola, G. S., Onwuka, C. F. I., and Uchegbu, M. C. (2020). Nutritional value of rice offal and its utilization in poultry diets. *International Journal of Livestock Production, 11*(4), 125–133. https://doi.org/10.5897/IJLP2020.0743

Olawoye, S. O., Olojede, A. O., and Alabi, O. M. (2021). Economics of feed resources and alternatives to maize and soybean meal in poultry production. *Applied Tropical Agriculture, 26*(2), 80–88.

Olukosi, O. A., Beeson, L. A., Englyst, K., and Bedford, M. R. (2020). Effects of exogenous enzymes on performance, nutrient utilization, and intestinal viscosity of broiler chickens fed diets containing different levels of wheat and rye. *Poultry Science, 99*(11), 5725–5736. https://doi.org/10.1016/j.psj.2020.07.018

Onyimonyi, A. E., and Okeke, G. C. (2021). Potentials of rice milling waste in poultry production: A review. *Asian Journal of Animal and Veterinary Advances, 16*(2), 44–52. https://doi.org/10.3923/ajava.2021.44.52

Oluwatosin, O. O., Oduguwa, O. O., and Odejide, J. O. (2019). Utilization of rice offal in broiler diets: Effects on performance and nutrient digestibility. *Nigerian Journal of Animal Science, 21*(3), 101–112.

Statistical package for social sciences (SPSS). Version 23. Polar Engineering and Consulting; 2015.

Tiwari, U. P., Singh, A. K., and Jha, R. (2021). Dietary fiber and its fermentation characteristics in poultry: Role of exogenous enzymes. *Animal Feed Science and Technology, 273*, 114823. https://doi.org/10.1016/j.anifeedsci.2020.114823

Weather Station. (2022). *Annual weather records for Adamawa State University Teaching and Research Farm*. Nigerian Meteorological Agency (NIMET).