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Growth Performance of Noiler Chickens Fed Diets Containing graded levels of Bovine Rumen Filtrate-Fermented Wheat Bran

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Abstract

This study evaluated the chemical composition of wheat bran fermented with bovine rumen filtrate and its effects on the growth performance of noiler chickens. Wheat bran was fermented using bovine rumen filtrate for a defined period, and its proximate composition was analyzed. The results showed a reduction in crude fibre content from 12.25% to 8.50% and an increase in crude protein from 14.50% to 15.10%, indicating an improvement in nutritive value. A feeding trial was conducted using 120 noiler chickens randomly assigned to four dietary treatments: 0% (control), 12.5%, 25%, and 50% inclusion levels of fermented wheat bran. The growth performance parameters assessed included initial and final body weight, feed intake, weight gain, feed conversion ratio (FCR), and mortality. Although significant differences ($p<0.05$) were observed in feed intake and average daily feed intake, no significant differences ($p>0.05$) occurred in weight gain, final body weight, or FCR. Birds fed diets containing fermented wheat bran performed comparably to the control, with no adverse effects on growth performance. These findings suggest that bovine rumen filtrate fermented wheat bran can serve as a viable alternative feed ingredient in noiler diets, potentially reducing reliance on conventional feed resources.

Introduction

The poultry industry plays a significant role in the global economy, and in Nigeria, it serves as a critical component of the livestock subsector. Its contributions to socioeconomic development are substantial, especially in terms of providing high-quality animal protein within a short production cycle and at a relatively low cost (Onunkwo *et al*., 2018). In particular, noiler meat is highly favored due to its low cholesterol content, prompting increased demand and a growing interest in enhancing both the scale and efficiency of noiler production (Ndelekwute *et al*., 2017).

Over the past two decades, Nigeria has witnessed remarkable growth in noiler production, driven by advances in research that have improved feed efficiency, growth rates, and overall productivity (Kafi et al., 2017). Among the key determinants of improved poultry production are genetics, health management, housing, and—most critically—nutrition. Indeed, feed costs constitute up to 70% of the total cost in intensive noiler operations (Ziggers, 2011; Adegbenro et al., 2018). Consequently, identifying and utilizing cost-effective feed resources without compromising nutritional quality remains a top priority for sustainable poultry production.

The escalating cost of conventional feed ingredients such as maize and soybean meal has become a significant barrier to expansion in the poultry sector in developing countries, including Nigeria (Aro & Ajiboye, 2016). Maize typically accounts for about 60% of poultry feed ingredients and up to 35% of the total feed cost (Samara, 2000), while soybean meal remains the primary protein source. This has spurred research into alternative feed resources, particularly agro-industrial by-products that are abundant, affordable, and nutritionally valuable.

Wheat bran, a by-product of wheat milling, is one such material. It contains about 15.2% crude protein (CP) but also up to 12% crude fiber (CF), which limits its inclusion level in noiler diets to under 5% due to poor digestibility (National Research Council [NRC], 1994). Despite this limitation, wheat bran is known to exhibit high phytase activity, which

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can enhance phosphorus utilization in monogastric animals like poultry (Lesson & Summers, 2008).

Another underutilized by-product with potential is rumen liquor, obtained from the digestive contents of slaughtered ruminant animals. Rumen liquor is rich in a consortium of fibrolytic and proteolytic microbes capable of degrading complex plant fibre and phytates. Fermenting wheat bran with bovine rumen filtrate may reduce its fiber content and increase the availability of phosphorus through microbial degradation, thereby improving its nutritional profile and usability in noiler diets.

To date, limited studies have evaluated the synergistic effects of fermenting wheat bran with rumen liquor on noiler performance. The action of rumen microbes—particularly through cellulase and phytase enzymes; may reduce the fibre and phytate content of wheat bran, enhancing its digestibility and nutritive value for poultry.

Therefore, the objective of this study was to evaluate the chemical composition of wheat bran fermented with bovine rumen filtrate and its effects on the growth performance of noiler chickens.

Materials and Methods

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike lies on latitude 05°29′N and longitude 07°32′E, with an elevation of approximately 123 meters above sea level. The area experiences an annual rainfall of 2,177 mm, relative humidity ranging from 50% to 90%, and ambient temperatures between 22°C and 36°C (Meteorological Station, NRCRI, Umudike, 2021).

Collection and Preparation of Rumen Liquor

Fresh bovine rumen liquor was obtained from freshly slaughtered animals at the Ubakala municipal abattoir, Abia State. Twelve fattened calves were slaughtered and their gastrointestinal tracts were collected under hygienic conditions and transferred to a sanitized processing area. The rumen contents were poured onto a fine mesh to separate the solid fraction from the liquid filtrate. The filtrate (rumen liquor) was then transferred into clean nylon bags. The entire collection and filtration process were completed within 10–15 minutes to minimize microbial degradation and loss of enzymatic activity.

Fermentation of Wheat Bran with Rumen Liquor

Commercial wheat bran, procured from a local supplier, was used as the substrate for fermentation. The freshly collected rumen liquor was evenly sprayed over the wheat bran, followed by thorough mixing to ensure uniform distribution. The treated bran was then sealed in airtight polyethylene bags to facilitate anaerobic fermentation at ambient room temperature. Fermentation was allowed to proceed for 24 days. Subsequently, the bags were transferred into airtight metallic containers for an additional 3 days to further enhance fermentation stability. After this period, the fermented wheat bran was sun-dried for approximately 30 hours until a consistent moisture level was achieved.

Samples of the dried fermented wheat bran were subjected to proximate composition analysis. Moisture content, crude protein, crude fibre, ether extract, ash, and gross energy were determined using standard procedures as outlined by the Association of Official Analytical Chemists (AOAC, 1995).

Experimental Diets and Bird Management

Four isonitrogenous and isoenergetic noiler starter diets were formulated for the study. The control diet (T1) contained no fermented wheat bran. Diets T2, T3, and T4 contained 5%, 10%, and 15% levels of fermented wheat bran, respectively. All dietary ingredients were purchased from a reputable local feed vendor. The diets were formulated to meet the nutrient requirements of noiler chickens based on the guidelines of the National Research Council (NRC, 1994) and Aduku (1993).

Day-old noiler chicks were randomly assigned to the four dietary treatments and offered the respective experimental diets and clean drinking water *ad libitum* from day one. All birds were managed under uniform environmental and hygienic conditions throughout the duration of the feeding trial. The gross and proximate compositions (%) of the experimental diets are presented in Table 1 and 2 respectively.

Table 1: Ingredient and nutrient composition of experimental Bovine rumen filtrate fermented wheat bran noiler chicken diet

Ingredients	T_1 (0.00%)	T_2 (0.5%)	T_3 (0.10%)	T_4 (0.15%)
Maize Meal	58.00	58.00	58.00	56.00
Soybean Meal	24.00	24.00	23.00	21.00
Palm Kernel Meal	11.30	6.30	2.30	1.30
Wheat Offal	0.00	5.00	10.00	15.00
Fish Meal	3.00	3.00	3.00	3.00
Bone Meal	3.00	3.00	3.00	3.00
Premix*	0.25	0.25	0.25	0.25

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Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
NaCl	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
ME (Kcal/kg)	2871.85	2971.85	3071.85	3175.85
Crude Protein (%)	23.97	23.57	23.17	22.97

Vit/Min premix (1kg) contained vitamin A (5000.00IU), vitamin A 3 (1,000,00), vitamin E (16,00mg), vitamin K (800mg), vitamin B1 (1200mg), vitamin B2 (22,000mg), Niacin (22,000mg), calcium pantothenate (4600mg), vitamin B6 (2000mg), vitamin B12 (10g), folic acid (400mg), Biotin (32mg), cholinv chloride (200,000mg), Manganese (948,000mg), iron (40,000mg), Zinc (32,000mg), Copper (3400mg), Iodine (600mg), Cobalt (120mg), Selenium (48mg), Anti-oxidant (48,00mg).

Table 2: Proximate Composition of Straight Noiler Chicken Diet containing Bovine Rumen filtrate fermented wheat bran

	T_1 (0.00 %)	**T_2 (0.5%)**	**T_3 (0.10%)**	**T_4 (0.15%)**
Dry matter (%)	89.64	89.38	89.35	89.16
Moisture (%)	10.36	10.62	10.65	10.84
Ash (%)	7.20	7.60	8.00	7.90
Crude Protein (%)	23.88	23.44	23.00	22.88
Ether Extract (%)	3.40	3.85	3.60	3.85
Crude Fibre (%)	5.70	5.85	5.95	7.05
NFE (%)	51.46	50.64	50.80	48.48

The design for the experiment was Completely Randomized Design (CRD) with the bovine rumen filtrate fermented wheat bran as the only factor of interest. The statistical model is shown below:

$Y_{ij} = \mu + T_i + e_{ij}$

Where,

Y_{ij}= Single observation

μ = Overall mean

T_i= Treatment effect

e_{ij} = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance.

Procurement of Chicks

A total of 120 unsexed day-old Noiler chicks were sourced from a reputable hatchery in Ibadan, Oyo State, Nigeria. All feed ingredients used in the formulation of the experimental diets were purchased from Jocan Feed Mill, Umuahia, Abia State.

Housing and Pre-Experimental Preparations

Prior to the arrival of the chicks, the experimental pens, surroundings, and equipment were thoroughly cleaned, disinfected, and left fallow for three weeks to eliminate residual pathogens. Two days before the chicks' arrival, wood shavings were evenly spread across the brooding floor, and newspapers were placed over the litter to enhance traction and comfort. Each partitioned pen was appropriately labeled for treatment identification. The brooding house was enclosed with tarpaulin for heat retention and pre-heated for at least 24 hours. All possible entry points for rodents and pests were sealed.

Brooding Phase

Upon arrival, the chicks were counted, weighed, and randomly allocated into four dietary treatments. Each treatment consisted of 30 chicks divided into three replicates (10 chicks per replicate). To mitigate transport-related stress, glucose was administered via drinking water. Chicks were brooded using a combination of electric bulbs, charcoal pots, and kerosene lamps for the first three weeks. Brooding temperatures were regularly monitored to ensure uniformity.

Grower Phase Management

After brooding, birds were transferred to the grower house and managed on a deep litter system. Feed and clean water were provided *ad libitum* throughout the experiment. Standard feeding and watering troughs were used. Litter management involved periodic removal and replacement of soiled bedding to maintain hygiene and bird comfort.

Health Management

Prophylactic health care measures were implemented throughout the experimental period. On day 1, the chicks were vaccinated against Newcastle Disease (NCD) via the intraocular route. On day 7, the birds were vaccinated against Infectious Bursal Disease (IBD) using drinking water. Booster vaccinations for NCD (LaSota strain) and IBD were administered via drinking water on days 21 and 28, respectively. Antibiotics and anti-stress supplements were provided as needed. Birds were monitored daily for clinical signs of disease, and biosecurity practices were strictly observed.

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Chemical Analysis of Experimental Diets

The proximate composition of the **bovine rumen filtrate-fermented wheat bran** included analysis of dry matter, crude protein, crude fibre, ether extract, and ash content. All determinations followed the standard procedures outlined by the **Association of Official Analytical Chemists (AOAC, 1990)**.

Growth Performance Evaluation

The birds were weighed at the start of the experiment and subsequently on a weekly basis. Feed intake and mortality were recorded daily. The following performance indices were calculated: Average Daily Feed Intake (g/bird/day), Average Daily Weight Gain (g/bird/day), Feed Conversion Ratio (FCR) and Mortality Rate (%)

Statistical Analysis

All data generated were subjected to analysis of variance (ANOVA) and treatment means that were significantly different were separated using Duncan's Multiple Range Test (Duncan, 1955) according to Steel and Torrie (1980) using computer software IBM SPSS Statistic version 20 (SPSS, 2009).

Results and Discussion

Chemical Composition of Fermented Wheat Bran

The chemical composition of wheat bran before and after fermentation with bovine rumen filtrate is presented in **Table 4.1**. The fermentation process notably altered the proximate composition of the wheat bran. Specifically, fermentation led to a reduction in crude fibre content from **12.25% to 8.50%**, and an increase in crude protein content from **14.50% to 15.10%**. This reduction in fibre is consistent with microbial degradation of complex fibrous materials during fermentation, enhancing nutrient availability.

These findings are in agreement with the report of **Adeyemi and Familade (2003)**, who observed a similar reduction in fibre and improvement in protein content when corn cobs were fermented using rumen filtrate. Their study showed a more drastic increase in crude protein and a significant drop in crude fibre, suggesting that rumen microbes are effective at enhancing the nutritional quality of fibrous feedstuffs.

In addition to changes in protein and fibre, there was also an increase in ether extract (fat content) from 3.65% to 6.95%, which could be due to microbial synthesis or concentration effects during fermentation. However, the gross energy value declined from 3895.20 kcal/kg to 3498.00 kcal/kg, which may be attributed to the partial loss of fermentable carbohydrates or an increase in indigestible microbial mass.

Yao et al. (2007) reported a proximate composition of wheat bran containing 15.52% crude protein, 4.70% ash, and 8.34% fibre, which supports the values observed in this study. Variations in these parameters across studies are expected due to differences in wheat varieties, processing techniques, and fermentation conditions.

While literature on fermented wheat bran is limited, the improved nutritional profile observed in this study suggests that bovine rumen filtrate fermentation can be a viable strategy for upgrading the nutritional quality of wheat bran for use in poultry diets.

Table 3: Chemical Composition of Wheat Bran Before and After Fermentation (Air Dry Basis)

Ingredient	Protein (%)	Ash (%)	Fat (%)	Fibre (%)	Gross Energy (Kcal/kg)
Wheat bran	14.50	4.00	3.65	12.25	3895.20
Fermented wheat bran	15.10	3.50	6.95	8.50	3498.00

Growth Performance of Noiler Chickens Fed Diets Containing Bovine Rumen Filtrate-Fermented Wheat Bran

The effect of including bovine rumen filtrate fermented wheat bran (BRF-WB) in noiler diets on growth performance is presented in Table 4. The diets contained varying inclusion levels: 0% (T1), 12.5% (T2), 25% (T3), and 50% (T4). Significant differences ($P<0.05$) were observed in initial body weight (IBW), average feed intake (AFI), and average daily feed intake (ADFI). However, no significant differences ($P>0.05$) were recorded for final body weight (FBW), average weight gain (AWG), average daily weight gain (ADWG), or feed conversion ratio (FCR) across the treatments.

The slightly higher average feed intake observed in T4 (1939.56 g/bird) compared to the control (T1: 2033.17 g/bird) and other treatments may explain its relatively better growth outcome. This suggests that the palatability and digestibility of the diet improved with BRF-WB inclusion. Nevertheless, the differences were not statistically significant in terms of final weight gain and FCR, indicating that the fermented wheat bran did not negatively impact performance, even at higher inclusion levels.

Lesson and Summers (2008) noted that wheat bran contains a relatively high protein content and can promote growth when used at appropriate levels in poultry diets. However, they emphasized that excessive fibre may limit its utility. Fermentation likely mitigated this concern in the current study by reducing the crude fibre content, thereby enhancing nutrient absorption.

The best feed conversion ratio (FCR = 1.01) was recorded in T3 (25% inclusion), which also exhibited a favourable balance between feed intake and weight gain. Although T4 had the highest final live weight, this was associated with increased feed intake rather than improved efficiency. These

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results are consistent with Fusayi and Nonyerem (2007), who attributed improved growth performance in poultry to feed ingredients rich in balanced amino acids, minerals, and essential fatty acids.

Furthermore, mortality rates across treatments were not significantly different and remained within acceptable limits, indicating that inclusion of fermented wheat bran posed no health risks to the birds.

In summary, the inclusion of up to 25% bovine rumen filtrate fermented wheat bran in noiler diets did not impair growth performance and may offer cost-effective nutritional benefits when used appropriately.

Table 4: Growth Performance of Noiler Chickens Fed Diets Containing Bovine Rumen Filtrate Fermented Wheat Bran

Parameters	T1 (0.00%)	T2 (12.5%)	T3 (25.0%)	T4 (50.0%)	SEM
IBW (g/b)	48.75	48.70	48.66	48.52	0.00
AFI (g/b)	2033.17^{ab}	1908.11^{ab}	1812.63^{b}	1939.56^{ab}	40.88
ADFI (g/b/d)	72.61^{ab}	68.15^{ab}	64.74^{b}	69.27^{ab}	1.46
FBW (g/b)	1941.67	1880.00	1833.33	1825.00	35.88
AWG (g/b)	1892.92	1831.30	1784.67	1776.48	33.49
ADWG (g/b/d)	33.80	32.70	31.87	31.72	1.20
FCR	1.07	1.04	1.01	1.09	0.08
Mortality Rate (%)	0.00	0.83	1.67	0.00	0.30

Note: Values with different superscripts within the same row are significantly different ($P<0.05$). **IBW** = Initial Body Weight, **FBW** = Final Body Weight, **AWG** = Average Weight Gain, **ADWG** = Average Daily Weight Gain, **AFI** = Average Feed Intake, **ADFI** = Average Daily Feed Intake, **FCR** = Feed Conversion Ratio

CONCLUSION

The results of this study demonstrated that fermentation of wheat bran with bovine rumen filtrate significantly improved its nutritional quality by reducing crude fibre and increasing crude protein and fat contents. The inclusion of fermented wheat bran in noiler diets up to 50% had no detrimental effects on growth performance, feed conversion efficiency, or survival rate. Although some variations were observed in feed intake across treatments, the birds maintained acceptable weight gain and feed efficiency throughout the study. This indicates that bovine rumen filtrate fermented wheat bran is a suitable alternative feed ingredient that can be utilized in noiler production without compromising productivity. Its use may contribute to reducing feed costs and promoting sustainable poultry nutrition by incorporating agro-industrial by-products. Further research is recommended to evaluate its effects on carcass characteristics and nutrient digestibility in noiler chickens.

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