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Growth Performance, Feed Efficiency, and Survivability of Dual-Purpose Noiler Chickens fed diet containing Probiotic Yeast (*Saccharomyces cerevisiae*) under Tropical Production Conditions

By

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Abstract

*The sustainability of poultry production in developing countries is increasingly constrained by rising feed costs and the need for antibiotic-free growth promotion strategies. Probiotic supplementation has emerged as a promising nutritional intervention to improve gut health, nutrient utilisation, and flock resilience. However, limited empirical data exist regarding the response of Noiler chickens, a dual-purpose hybrid widely adopted in Nigeria, to probiotic yeast supplementation. This study evaluated the effects of graded dietary levels of *Saccharomyces cerevisiae* on growth performance, feed utilisation, and survivability of Noiler chickens under humid tropical conditions. A total of 300 day-old mixed-sex Noiler chicks were randomly allocated to five dietary treatments in a completely randomised design, with three replicates of 20 birds each. The treatments consisted of a control diet (0% yeast) and diets supplemented with 0.5%, 1.0%, 1.5%, and 2.0% *S. cerevisiae*. Birds were reared for 16 weeks under standard management practices. Growth indices, feed intake, feed conversion ratio (FCR), mortality, and livability were evaluated. Data were analysed using one-way ANOVA, and treatment means were separated using Duncan's multiple range test at $P < 0.05$. Dietary supplementation with *S. cerevisiae* did not significantly affect final body weight, total weight gain, average daily gain, feed intake, or FCR ($P > 0.05$). However, numerical improvements were observed at 0.5% and 2.0% inclusion levels, with birds in the 0.5% group recording the highest final body weight (2200 g) and average daily gain (20.45 g/bird/day). The best feed conversion ratio (0.90) was obtained at 2.0% inclusion. Mortality and livability were significantly influenced by dietary treatments ($P < 0.05$), with the 2.0% supplementation group recording the lowest mortality (5.00%) and highest livability (95.00%). These findings suggest that while *S. cerevisiae* supplementation exerted limited growth-promoting effects under nutritionally adequate diets, higher inclusion levels improved flock survivability and overall robustness. The results indicate that *S. cerevisiae* may function more effectively as a health-supporting and resilience-enhancing feed additive rather than a direct growth promoter in Noiler chickens. Inclusion at 2.0% is recommended to enhance survivability without compromising performance, particularly in smallholder and semi-intensive tropical production systems. This study provides evidence-based guidance for integrating probiotic yeast into sustainable and antibiotic-reduction poultry nutrition strategies in emerging economies.*

Keywords: Growth Performance, Feed Efficiency, Survivability, Dual-Purpose, Noiler

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INTRODUCTION

The poultry industry plays a critical role in ensuring global food security by providing affordable and high-quality animal

protein in the form of meat and eggs. However, the sustainability of poultry production systems is increasingly threatened by rising feed ingredient costs, largely due to competition between humans and livestock for conventional

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feed resources such as maize and soybean meal (Goffeau et al., 1996). Feed costs account for approximately 60–70% of total poultry production expenses, making efficient feed utilisation a major determinant of profitability, particularly in developing countries.

Recent advances in animal nutrition emphasise the adoption of low-cost, locally available, and non-competitive feed strategies that enhance productivity while safeguarding animal health and environmental sustainability (Iji et al., 2017; Tanimu et al., 2020). This need is particularly urgent in Nigeria, where rapid population growth continues to exert pressure on food systems. Nigeria's population was estimated at over 210 million, with an annual growth rate of about 2.58%, necessitating intensified, efficient livestock production systems to meet increasing demand for animal protein (Worldometer, 2020; Doolittle, 2009).

In response to these challenges, Noiler chickens, a dual-purpose hybrid breed developed in Nigeria by Amo Farm Sieberer Hatchery, have gained increasing acceptance among poultry farmers. The Noiler is a cross between Nigerian indigenous chickens and the White Plymouth Rock, combining adaptability to tropical environments with improved growth and egg production traits (Foury et al., 1998; Thomson et al., 2005). This breed is characterized by high survival rates, resistance to common poultry diseases, and tolerance to harsh climatic conditions (Futcher, 1998). Moreover, Noiler chickens can thrive under intensive, semi-intensive, and scavenging systems, thereby reducing feed and management costs (Wicker, 1996).

Noiler chickens attain market weights of approximately 2.6 kg for males and 2.2 kg for females by 13 weeks of age, while hens commence egg production at around five months, producing between 150 and 200 eggs annually (Ihmel et al., 2005). These attributes make Noilers economically attractive, particularly for smallholder and resource-limited farmers, and position them as a viable tool for improving food security and rural livelihoods (Hayman et al., 2013).

Despite these advantages, optimizing the productivity of Noiler chickens requires targeted nutritional interventions that enhance gut health, nutrient utilization, and immune competence. One promising approach is the use of probiotics, particularly *Saccharomyces cerevisiae*. *S. cerevisiae* is a yeast-based probiotic widely reported to improve digestion, intestinal morphology, nutrient absorption, and feed conversion efficiency in poultry through modulation of gut microflora and enhancement of intestinal integrity (Galeote et al., 2008; Taylor et al., 2014). Additionally, probiotic supplementation has been associated with improved immune response and reduced reliance on antibiotic growth promoters.

Although the beneficial effects of *Saccharomyces cerevisiae* supplementation have been extensively studied in broilers and layers, information on its application in Noiler chickens remains limited. Given the increasing importance of Noilers in Nigeria's poultry industry, there is a clear need for empirical data to establish optimal inclusion levels and evaluate its effects on growth performance, gut health,

nutrient retention, carcass characteristics, and haematological indices.

Therefore, this study was designed to investigate the effects of graded levels of *Saccharomyces cerevisiae* supplementation on growth performance, feed utilization, gut morphology, microbial balance, nutrient retention, carcass quality, and blood profile of Noiler chickens, with a view to providing evidence-based recommendations for sustainable and profitable poultry production.

Materials and Methods

Experimental Location

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located at a latitude of 5°27' N and a longitude of 7°32' E, with an altitude of approximately 123 m above sea level. The area lies within the humid rainforest zone of south-eastern Nigeria and is characterised by an annual rainfall of about 2177 mm, ambient temperature ranging from 22 to 36 °C, and relative humidity between 50 and 90% (NRCRI, 2017).

Experimental Birds and Management

A total of 300 day-old Noiler chicks of mixed sexes were used for the experiment. The chicks were sourced from a certified day-old chick distributor in Owerri, Imo State, Nigeria. Upon arrival, the birds were brooded for one week to allow acclimatisation to the experimental environment. During the brooding phase, chicks were fed a commercial starter diet.

Heat was provided using kerosene lanterns, charcoal stoves, and 200-W electric bulbs. Tarpaulin sheets were used to cover exposed sections of the poultry house to prevent cold stress. The birds were housed in deep litter pens throughout the experiment, with wood shavings used as litter material. Feed and clean drinking water were supplied ad libitum.

Routine vaccination and medication schedules were strictly followed. On day one, birds were vaccinated against Newcastle disease via the intraocular route, and glucose was administered in drinking water to reduce stress. Vitamins and minerals were provided on day two. Birds were vaccinated against infectious bursal disease (Gumboro) on day 11 and Newcastle disease on day 28. Deworming was carried out on day 42. Prophylactic medications were administered against common poultry diseases such as salmonellosis, colibacillosis, coccidiosis, and chronic respiratory disease, following standard poultry health management practices (FAO, 2013). The feeding trial lasted 16 weeks.

Experimental Design and Diets

The experiment was laid out in a completely randomised design (CRD) consisting of five dietary treatments. Each treatment had three replicates, with 20 birds per replicate, giving a total of 60 birds per treatment.

Five experimental diets were formulated as follows:

- i. **T1:** Control diet (0% *Saccharomyces cerevisiae*)
- ii. **T2:** Diet containing 0.5% *Saccharomyces cerevisiae*
- iii. **T3:** Diet containing 1.0% *Saccharomyces cerevisiae*
- iv. **T4:** Diet containing 1.5% *Saccharomyces cerevisiae*

v. **T5:** Diet containing 2.0% *Saccharomyces cerevisiae*

The yeast (*Saccharomyces cerevisiae*) used was a commercial feed-grade probiotic. All diets (Tables 1 and 2) were formulated to meet or exceed the nutrient requirements for Noiler chickens as recommended by NRC (1994).

TABLE 1: Percentage composition of Starter Noiler fed diets containing supplemental levels of *Saccharomyces Cerevisiae*

INGREDIE NTS (kg)	T1	T2	T3	T4	T5
Maize	40	40	40	40	40
Wheat offal	14	14.5	15	15.5	16
SC	–	0.5	1.0	1.5	2.0
Brewers Dry Grain	12	12	12	12	12
Soybean meal	20	20	20	20	20
Fish meal	3	3	3	3	3
Palm Kernel Cake	8	8	8	8	8
Bone meal	2.2	2.2	2.2	2.2	2.2
Lysine	0.2	0.2	0.2	0.2	0.2
Methionine	0.1	0.1	0.1	0.1	0.1
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total (kg)	100	100	100	100	100
Calculated composition					
Crude protein (%)	21.90	21.72	21.61	21.42	21.23
Energy (Kcal/kg ME)	2895.97	2874.12	2862.27	2843.42	2821.57
Crude fibre (%)	4.87	5.12	5.23	5.44	5.54

TABLE 2: Percentage composition of Grower Noiler fed diets containing supplemental levels of *Saccharomyces Cerevisiae*

INGREDIE NTS (kg)	T1	T2	T3	T4	T5
Maize	46	46	46	46	46
Wheat offal	14	14.5	15	15.5	16
SC	–	0.5	1.0	1.5	2.0
Brewers Dry Grain	13	13	13	13	13
Soybean meal	15	15	15	15	15

Soybean meal					
Fish meal	3	3	3	3	3
Palm Kernel Cake	6	6	6	6	6
Bone meal	2.2	2.2	2.2	2.2	2.2
Lysine	0.2	0.2	0.2	0.2	0.2
Methionine	0.1	0.1	0.1	0.1	0.1
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total (kg)	100	100	100	100	100
Calculated composition					
Crude protein (%)	19.70	19.62	19.41	19.22	19.13
Energy (Kcal/kg ME)	3015.97	3009.12	3002.27	2998.42	2970.57
Crude fibre (%)	5.21	5.41	5.53	5.64	5.74

PARAMETERS MEASURED

Growth Performance and Feed Utilisation

The objective is to evaluate the effects of graded dietary levels of *Saccharomyces cerevisiae* on growth performance, feed intake, and feed conversion ratio (FCR) of Noiler chickens.

Data Collection

Growth Performance

The initial live weight of the broiler chicks at day old was recorded. The birds were weekly weighed to determine the live weight and weight gain. The quantity of feed offered to the birds daily and the left over the next morning were measured to ascertain feed intake. Mortality was noted.

Feed Intake

Daily feed intake was determined by measuring the difference between the quantity of feed offered and the quantity left over the following day. Weekly feed intake was obtained by summing daily intakes.

The data obtained was used to obtain the following parameters. The following parameters were calculated using standard procedures (Aderemi et al., 2012; Oluyemi and Roberts, 2000):

$$\begin{aligned} \text{Average Daily Feed Intake (g/bird/day)} &= \frac{\text{Quantity of feed given} - \text{Quantity left over}}{\text{Number of birds} \times \text{Number of days}} \\ \text{Average Daily Weight Gain (g/bird/day)} &= \frac{\text{Final live weight} - \text{Initial live weight}}{\text{Number of birds} \times \text{Number of days}} \\ \text{Feed Conversion Ratio (FCR)} &= \frac{\text{Average daily feed intake per bird}}{\text{Average daily weight gain per bird}} \end{aligned}$$

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$$\text{Mortality rate (\%)} = \frac{\text{Number of dead birds}}{\text{Initial stock} \times \text{Number of weeks}} \times \frac{100}{1}$$

Statistical Analysis

All data collected were subjected to one-way analysis of variance (ANOVA) using Statistical Analysis System (SAS, 2012). Differences among treatment means were separated using Duncan's multiple range test at a significance level of $P < 0.05$. Results were expressed as means \pm standard error of the mean.

Results and Discussion

The growth performance and feed utilisation of Noiler chickens fed diets containing supplemental levels of *Saccharomyces cerevisiae*

Growth performance

The effects of dietary supplementation with graded levels of *Saccharomyces cerevisiae* on the growth performance and feed utilisation of Noiler chickens are presented in Table 3. All birds had identical initial body weights (52.67 g), indicating uniformity at the start of the experiment. Dietary supplementation with *S. cerevisiae* had no significant effect ($P > 0.05$) on final body weight, total weight gain, average daily weight gain, total feed intake, daily feed intake, or feed conversion ratio. However, mortality and livability differed significantly ($P < 0.05$) among the dietary treatments.

Final body weight ranged from 1966.17 g to 2200.00 g. Birds fed the diet containing 0.5% *S. cerevisiae* (T2) recorded the highest final body weight (2200.00 g) and weight gain (2157.33 g), followed by birds fed 2.0% inclusion (T5). Although these numerical differences were not statistically significant, they suggest a positive growth response to low-to-moderate inclusion levels of *S. cerevisiae*. The improved growth performance observed in T2 may be attributed to enhanced nutrient digestion and absorption associated with probiotic yeast supplementation, which improves gut microbial balance and enzymatic activity.

This trend agrees with the findings of Ahiwe et al. (2019), who reported improved body weight gain in broiler chickens fed *S. cerevisiae*-supplemented diets compared with unsupplemented controls. Similar improvements were reported by Alkhalif et al. (2010), who observed increased body weight and daily weight gain in broilers between 3 and 6 weeks of age when yeast was included in the diet.

Average daily weight gain followed a pattern similar to total weight gain. Birds in T2 recorded the highest average daily weight gain (20.45 g/bird/day), while the lowest value was observed in T4 (18.23 g/bird/day). Although the differences were not significant ($P > 0.05$), the numerical advantage of T2 suggests that 0.5% inclusion level may represent an optimal dosage for growth stimulation in Noiler chickens under the conditions of this study. This observation supports earlier reports that moderate yeast inclusion levels are more effective

than excessive supplementation (Ahiwe et al., 2019; Alkhalif et al., 2010).

Growth performance and feed utilisation

Dietary supplementation with *Saccharomyces cerevisiae* did not significantly affect final body weight, weight gain, average daily gain, feed intake, or feed conversion ratio ($p > 0.05$), whereas mortality and livability differed significantly among treatments ($p < 0.05$) (Table 3). Uniform initial body weights across treatments confirmed adequate randomisation and comparability at trial onset.

Although differences in growth indices were not statistically significant, birds receiving *S. cerevisiae*-supplemented diets, particularly at 0.5% (T2) and 2.0% (T5), showed numerically higher final body weight and weight gain relative to the control. These trends suggest a modest growth-promoting effect of yeast supplementation, consistent with reports that *S. cerevisiae* enhances gut microbial balance, nutrient digestibility, and intestinal integrity through its content of β -glucans, mannan oligosaccharides, and B-complex vitamins (Alkhalif et al., 2010; Ahiwe et al., 2019). However, the absence of statistical significance indicates that under the present management and diet composition, growth responses were limited.

Feed intake and feed conversion ratio followed similar patterns, with no significant treatment effects. The numerically lower feed conversion ratio observed in birds fed 2.0% *S. cerevisiae* suggests improved feed utilisation efficiency, potentially due to enhanced enzymatic activity and microbial fermentation in the gastrointestinal tract (Shareef and Dabbagh, 2009). Nevertheless, the lack of consistent statistical differences implies that the basal diet may have already met nutrient requirements adequately, reducing the scope for pronounced probiotic responses—an outcome commonly reported in well-formulated diets (Gaggia et al., 2010).

In contrast, mortality and livability responded significantly to dietary treatments. Birds fed the 2.0% *S. cerevisiae* diet recorded the highest livability and lowest mortality, indicating a beneficial effect of yeast supplementation on flock health and resilience. Probiotic yeasts are known to enhance immune competence, reduce pathogen colonisation, and improve stress tolerance, which collectively contribute to improved survivability (Patterson and Burkholder, 2003). The elevated mortality observed in the 1.5% treatment likely reflects non-dietary factors such as environmental or management stress, as growth and feed utilisation parameters did not deteriorate proportionately.

Overall, these findings suggest that while *S. cerevisiae* supplementation exerted limited influence on growth performance under the conditions of this study, higher inclusion levels may confer health-related advantages, particularly in terms of survivability—an outcome of practical relevance in Noiler production systems.

Table 3: GROWTH PERFORMANCE OF NOILER CHICKEN FED DIET CONTAINING SUPPLEMENTAL LEVELS OF SACCHAROMYCES CEREVISIAE

Parameter	T1 (0%)	T2 (0.5%)	T3 (1.0%)	T4 (1.5%)	T5 (2.0%)	SEM
Initial weight (g/bird)	52.67	52.67	52.67	52.67	52.67	0.25
Final weight (g/bird)	2100.00	2200.00	2000.00	1966.17	2133.33	35.49
Weight gain (g/bird)	2047.33	2157.33	1914.67	1964.00	2096.33	44.45
Average daily gain (g/bird/day)	19.50	20.45	18.48	18.23	19.82	0.44
Total feed intake (g/bird)	1924.72	2011.45	2062.67	1446.99	2003.89	126.69
Daily feed intake (g/bird/day)	19.90	19.22	19.64	19.79	19.08	0.16
Feed conversion ratio	1.02	0.96	1.06	1.09	0.90	0.03
Mortality (%)	10.00 ^c	8.33 ^d	11.67 ^b	13.33 ^a	5.00 ^c	0.77
Livability (%)	90.00 ^c	94.67 ^b	88.33 ^d	86.67 ^c	95.00 ^a	0.77

Values are means of replicates. SEM = standard error of the mean. Means within a row with different superscripts (a–e) differ significantly ($p < 0.05$).

Feed intake and feed conversion ratio

Total feed intake and daily feed intake were not significantly influenced ($P > 0.05$) by dietary supplementation with *S. cerevisiae*. Total feed intake ranged from 1446.99 g in T4 to 2062.67 g in T3. Birds fed 1.0% *S. cerevisiae* (T3) recorded the highest total feed intake, followed closely by those in T5 (2.0%). The observed increase in feed intake may be associated with improved gut health and feed palatability, which are commonly linked to probiotic yeast supplementation.

Feed conversion ratio (FCR) also did not differ significantly ($P > 0.05$) among treatments. However, birds fed 2.0% *S. cerevisiae* (T5) recorded the best (lowest) FCR value (0.90), followed by T2 (0.96), indicating improved feed utilisation efficiency. The improved FCR observed at higher inclusion levels may be due to enhanced nutrient availability and metabolic efficiency resulting from improved intestinal microbial ecology.

These findings are consistent with the report of Shareef and Dabbagh (2009), who observed improved feed efficiency and nutrient utilisation in broiler chickens fed diets supplemented with *S. cerevisiae* at inclusion levels ranging from 1.0 to 2.0%.

Mortality and livability

Mortality and livability were significantly affected ($P < 0.05$) by dietary treatments. Mortality ranged from 5.00% in T5 (2.0%) to 13.33% in T4 (1.5%), while livability ranged from 86.67% to 95.00% across treatments. Birds fed 2.0% *S. cerevisiae* (T5) recorded the lowest mortality and highest livability, suggesting a beneficial effect of higher yeast inclusion on bird survivability.

The improved livability observed in T5 may be attributed to the immunomodulatory properties of *S. cerevisiae*, which has been reported to enhance disease resistance and stress tolerance in poultry through improved gut integrity and immune response (Gao et al., 2008; Alkhalif et al., 2010). Conversely, the higher mortality observed in T4 may be associated with non-dietary factors such as environmental stress or management-related challenges, as mortality patterns did not follow a consistent dose-dependent trend.

Conclusion

Overall, the results indicate that dietary supplementation with *Saccharomyces cerevisiae* did not adversely affect growth performance or feed utilisation of Noiler chickens. While most growth parameters were not significantly influenced, numerical improvements in body weight gain, feed conversion ratio, and livability, particularly at 0.5% and 2.0% inclusion levels, suggest potential benefits of yeast supplementation under practical production conditions. These findings support the use of *S. cerevisiae* as a natural growth-enhancing and health-promoting feed additive in Noiler chicken production.

Conclusion

In line with the objective of evaluating the growth performance and feed utilisation of Noiler chickens fed diets supplemented with *Saccharomyces cerevisiae*, the study demonstrated that yeast inclusion up to 2.0% did not significantly alter growth or feed efficiency but improved livability and reduced mortality. This indicates that *S. cerevisiae* supplementation may be more effective as a health-supporting additive than as a direct growth promoter under optimal feeding conditions. Consequently, inclusion levels around 2.0% may be beneficial in enhancing flock robustness without compromising performance, particularly in smallholder or semi-intensive production systems.

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