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Organoleptic response and meat quality of Noiler chickens fed diets containing different supplemental levels of *Saccharomyces cerevisiae*

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Abstract

*This study evaluated the effects of graded dietary supplementation of *Saccharomyces cerevisiae* on the organoleptic response and meat quality characteristics of Noiler chickens reared under tropical production conditions. A total of 300 day-old Noiler chicks were randomly assigned to five dietary treatments in a completely randomised design for 16 weeks. The treatments comprised a basal diet without yeast (T1) and diets supplemented with 0.5% (T2), 1.0% (T3), 1.5% (T4) and 2.0% (T5) *S. cerevisiae*. At the end of the feeding trial, breast muscle samples were evaluated for physicochemical properties (pH, water-holding capacity, cooking loss, drip loss, colour), proximate composition, lipid oxidation and sensory attributes using standard analytical procedures and a 9-point hedonic scale. Data were analysed using one-way ANOVA, and differences among means were separated at $P < 0.05$. Significant ($P < 0.05$) differences were observed in muscle pH, water-holding capacity, cooking loss and drip loss. Birds fed 2.0% yeast exhibited the highest ultimate pH (6.67), whereas moderate inclusion levels (1.0–1.5%) maintained pH values within the optimal range for poultry meat. Water-holding capacity decreased, and cooking loss increased at 2.0% inclusion, suggesting altered post-mortem muscle protein interactions at higher supplementation levels. Meat colour distribution differed significantly among treatments ($P = 0.0032$), with yeast-fed groups exhibiting improved visual appearance without evidence of pale, soft and exudative or dark, firm and dry conditions. Proximate analysis revealed enhanced crude protein and ash contents at 1.0% and 1.5% supplementation, with the highest crude protein value (75.06%) recorded in birds fed 1.0% yeast. Ether extract was not significantly affected, indicating that yeast supplementation did not adversely influence intramuscular fat deposition. Sensory evaluation demonstrated significant differences in tenderness ($P < 0.05$), with birds fed 1.5% *S. cerevisiae* receiving the highest tenderness scores and favourable overall acceptability ratings. Moderate inclusion levels (1.0–1.5%) consistently produced meat with superior nutritional profile and desirable organoleptic characteristics. In conclusion, dietary supplementation of *Saccharomyces cerevisiae* modulated post-mortem muscle biochemistry and enhanced selected meat quality and sensory attributes of Noiler chickens. Optimal responses were observed at 1.0–1.5% inclusion levels, which improved crude protein content, mineral deposition and tenderness without compromising technological quality traits. These findings demonstrate that strategic yeast supplementation can enhance the market value and consumer appeal of dual-purpose poultry meat under tropical production systems.*

Keyword: Organoleptic response, meat quality, Noiler chickens, *Saccharomyces cerevisiae*

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INTRODUCTION

The poultry industry remains one of the fastest-growing livestock subsectors globally and plays a critical role in bridging the animal protein gap, particularly in developing countries. However, the sector faces persistent challenges, notably the escalating cost of feed arising from competition between humans and livestock for cereals and oilseeds. Feed accounts for approximately 70–75% of total production costs in intensive poultry systems, thereby threatening profitability

and sustainability (Iji et al., 2017; Tanimu et al., 2020). In Nigeria, where the population exceeds 200 million and continues to grow at over 2% annually (World Bank, 2023), the demand for affordable, high-quality animal protein is increasing steadily. Consequently, there is an urgent need to shorten production cycles, enhance feed efficiency, and adopt nutritionally strategic interventions that improve meat yield and quality while reducing production costs.

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Recent advances in animal nutrition have emphasised the use of natural feed additives as alternatives to antibiotic growth promoters, whose use has been restricted globally due to concerns regarding antimicrobial resistance and food safety (World Health Organization, 2019). Functional additives such as probiotics, prebiotics and yeast-based products are increasingly recognised for their roles in improving gut integrity, nutrient utilisation, immune competence and overall physiological stability (Elghandour et al., 2020; Alagawany et al., 2023). Beyond growth performance, there is growing scientific and commercial interest in how such additives influence meat quality traits and organoleptic properties, which ultimately determine consumer acceptance and market value.

Noiler chickens, a dual-purpose hybrid developed in Nigeria by Amo Farm Sieberer Hatchery, are the result of strategic crossbreeding between Nigerian indigenous chickens and broiler-type strains, including the White Plymouth Rock. This genetic combination confers relatively rapid growth, adaptability to tropical environments, improved survivability under semi-intensive systems, and dual functionality for meat and egg production. Male Noilers can attain market weights of approximately 2.5–2.8 kg by 12–14 weeks, while females commence laying at around 20–22 weeks, producing 150–200 eggs annually under appropriate management conditions. Their hardiness, scavenging ability and moderate input requirements make them particularly suitable for small-holder farmers and resource-constrained production systems, thereby contributing to rural livelihoods and food security.

Despite these advantages, optimisation of carcass characteristics and meat quality in Noilers remains nutritionally driven. Meat quality attributes—including pH, colour, water-holding capacity, tenderness, lipid stability and flavour—are influenced by genotype, diet composition and gut microbial balance. Increasing consumer awareness regarding food safety and sensory attributes has heightened the importance of organoleptic evaluation (appearance, aroma, flavour, juiciness and tenderness) in poultry research (Liu et al., 2022). Nutritional interventions capable of modulating lipid metabolism and oxidative stability may directly influence sensory characteristics and shelf life of poultry meat.

Saccharomyces cerevisiae, a non-pathogenic yeast widely used as a probiotic in animal feeding, contains bioactive components such as β -glucans and mannan-oligosaccharides that enhance gut health, improve nutrient digestibility and stimulate immune responses. Supplementation with *S. cerevisiae* has been associated with improved growth performance, antioxidant status, lipid metabolism and carcass traits in broiler chickens (Elghandour et al., 2020; Abdel-Rahman et al., 2022; Alagawany et al., 2023). Yeast supplementation has also been reported to reduce lipid oxidation and improve meat oxidative stability, thereby potentially enhancing sensory attributes and extending shelf life (Liu et al., 2022).

However, empirical data on the influence of graded levels of *S. cerevisiae* on organoleptic response and meat quality of Noiler chickens under tropical production conditions remain limited. Given the unique genetic background and adaptive characteristics of Noilers, extrapolation from conventional broiler studies may not fully reflect their physiological responses. Therefore, a systematic evaluation of the effects of dietary *S. cerevisiae* supplementation on meat quality parameters and sensory acceptability in Noiler chickens is warranted. Generating such evidence will contribute to the development of cost-effective feeding strategies aimed not only at improving productivity but also at enhancing meat quality and consumer satisfaction in dual-purpose poultry systems.

MATERIALS AND METHODS

Experimental Location

The study 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, at 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 a mean annual rainfall of approximately 2,177 mm, ambient temperature ranging from 22 to 36 °C, and relative humidity of 50–90% (NRCRI, 2017). These environmental conditions typify tropical production systems under which dual-purpose chickens are commonly reared.

Experimental Birds and Management

A total of 300 day-old Noiler chickens (mixed sex) were used for the 16-week feeding trial. The chicks were obtained from a reputable commercial distributor in Owerri, Imo State, Nigeria. Upon arrival, birds were brooded for seven days to allow acclimatisation. During the brooding phase, commercial starter feed was provided, and supplemental heat was supplied using 200-W electric bulbs, kerosene lanterns and charcoal stoves. Tarpaulin sheets were used to minimise draught and cold stress.

After brooding, birds were individually weighed and randomly allocated to five dietary treatments in a completely randomised design (CRD). Each treatment consisted of 60 birds, with three replicates of 20 birds per replicate. Birds were reared on deep litter pens bedded with clean wood shavings throughout the experimental period. Feed and fresh drinking water were supplied ad libitum.

Routine vaccination and health management were carried out according to standard poultry management practices. Birds were vaccinated against Newcastle disease (intra-ocular route) on day 1, infectious bursal disease (Gumboro) on day 11, and Newcastle disease (Lasota strain) on day 28. Deworming was conducted at week 6. Vitamin–mineral supplements and glucose were administered in drinking water during periods of stress. Prophylactic measures against common bacterial and parasitic infections were applied as required. All procedures complied with institutional guidelines for the care and use of experimental animals and followed internationally recognised welfare standards (OIE, 2022).

Experimental Diets

Five iso-nitrogenous and iso-caloric diets were formulated to meet or exceed the nutrient requirements of growing chickens as recommended by the National Research Council (NRC, 1994). The dietary treatments were as follows:

- i. **T1:** Basal diet (0% *Saccharomyces cerevisiae*)
- ii. **T2:** Basal diet + 0.5% *Saccharomyces cerevisiae*
- iii. **T3:** Basal diet + 1.0% *Saccharomyces cerevisiae*
- iv. **T4:** Basal diet + 1.5% *Saccharomyces cerevisiae*
- v. **T5:** Basal diet + 2.0% *Saccharomyces cerevisiae*

The yeast product used was a commercial live yeast preparation containing $\geq 1 \times 10^9$ CFU/g. Diets were thoroughly mixed to ensure uniform distribution of the supplement. Birds were fed starter diets during the early growth phase and grower diets thereafter. 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
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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
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

Slaughter Procedure and Sample Collection

At the end of the 16-week feeding period, three birds per replicate (nine birds per treatment), representing the average body weight of each replicate, were randomly selected for carcass and meat quality evaluation. Birds were fasted for 12 hours with access to water before slaughter. Slaughtering was carried out humanely by cervical dislocation followed by exsanguination in accordance with standard ethical procedures (OIE, 2022).

Carcasses were defeathered, eviscerated and washed. Dressed weight was recorded, and breast muscle samples (pectoralis major) were excised for physicochemical and sensory analyses. Samples were transported to the laboratory under chilled conditions (4 °C) for immediate analysis.

Meat Quality Evaluation

pH Measurement

Muscle pH was measured at 45 minutes (pH₄₅) and 24 hours (pH₂₄) post-mortem using a calibrated digital pH meter equipped with a penetration electrode. Measurements were taken at three different points in the breast muscle, and the average value was recorded.

Colour Determination

Meat colour parameters (L* = lightness, a* = redness, b* = yellowness) were determined using a portable colourimeter following the CIE colour system. Measurements were taken after allowing the muscle surface to bloom for 30 minutes at 4 °C (AMSA, 2012).

Water-Holding Capacity and Cooking Loss

Water-holding capacity (WHC) was determined using the filter paper press method. Cooking loss was evaluated by weighing standardised breast meat samples before and after cooking in a water bath at 80 °C until an internal temperature of 75 °C was reached. Cooking loss was expressed as a percentage of initial weight (Honikel, 1998).

Proximate Composition

Moisture, crude protein, ether extract and ash contents of breast meat samples were analysed according to standard procedures of the Association of Official Analytical Chemists (AOAC, 2019).

Lipid Oxidation

Lipid oxidation was assessed using the thiobarbituric acid reactive substances (TBARS) assay, and results were expressed as mg malondialdehyde/kg meat (Botsoglou et al., 1994).

Organoleptic (Sensory) Evaluation

Sensory evaluation was conducted using a semi-trained panel of 10–12 members familiar with poultry meat assessment. Cooked breast meat samples were cut into uniform cubes, coded and presented randomly to panellists under controlled lighting conditions.

Attributes evaluated included colour, aroma, flavour, tenderness, juiciness and overall acceptability, using a 9-point hedonic scale (1 = dislike extremely; 9 = like extremely). Water was provided for palate cleansing between samples. Sensory evaluation procedures followed established guidelines for meat sensory analysis (AMSA, 2015).

Carcass Traits and Internal Organ Weights

Dressed weight, dressing percentage and relative weights of internal organs (liver, heart, gizzard, spleen and abdominal fat) were recorded and expressed as a percentage of live body weight.

Statistical Analysis

Data were subjected to one-way analysis of variance (ANOVA) using SPSS (Version 25.0). Differences among treatment means were separated using Duncan’s multiple range test. Significance was declared at P < 0.05.

RESULTS AND DISCUSSION

Meat Quality Characteristics

The effects of graded dietary supplementation of *Saccharomyces cerevisiae* on the meat quality of Noiler chickens are presented in Table 3. Significant (P < 0.05) differences were observed among treatments for muscle pH, water-holding capacity (WHC), cooking loss and drip loss, indicating that yeast inclusion influenced post-mortem muscle biochemistry and water retention properties.

Muscle pH

Muscle pH differed significantly (P < 0.05) among treatments. Birds fed 2.0% *S. cerevisiae* (T5) recorded the highest ultimate pH (6.67), whereas values for T1–T4 ranged from 5.03 to 5.63. The relatively higher pH observed at 2.0% inclusion may suggest reduced post-mortem glycolysis or altered glycogen reserves at slaughter. Muscle pH is a critical determinant of meat quality, influencing colour, WHC and tenderness (Petracci et al., 2015).

The present findings contrast with those of Md-Raihanul Hoque et al. (2021), who reported no significant effect of 1% yeast supplementation on broiler meat pH. Similarly, Han et al. (2010) observed no pH alteration at 1.5% inclusion. Differences may be attributed to genotype (Noiler vs commercial broilers), age at slaughter (16 weeks in the present study), tropical rearing conditions, and inclusion level. Dual-purpose genotypes such as Noilers may exhibit distinct muscle metabolic responses compared with fast-growing broilers (Mir et al., 2017).

Water-Holding Capacity, Cooking Loss and Drip Loss

Water-holding capacity decreased significantly (P < 0.05) as yeast inclusion increased, with T1 recording the highest WHC and T5 the lowest. Conversely, cooking loss and drip loss increased progressively, with the highest values observed at 2.0% inclusion. These changes correspond with the elevated muscle pH at higher inclusion levels and may reflect structural modifications in muscle proteins affecting fluid retention.

WHC is closely associated with protein denaturation and muscle fibre integrity (Huff-Lonergan & Lonergan, 2005). The increase in cooking and drip losses at higher inclusion levels suggests that excessive yeast supplementation may have altered muscle protein interactions or osmotic balance. This finding is not consistent with Han et al. (2010), who reported no significant differences in WHC or cooking loss at 1.5% yeast inclusion in broilers. However, the moderate inclusion levels (0.5–1.5%) in the present study produced intermediate values, suggesting that optimal supplementation may preserve muscle structural stability while excessive inclusion may compromise water retention.

Overall, moderate supplementation (0.5–1.5%) appeared to maintain acceptable technological meat quality traits, whereas 2.0% inclusion altered post-mortem muscle characteristics.

Table 3: MEAT QUALITY OF NOILER CHICKENS FED DIETS CONTAINING SUPPLEMENTAL LEVELS OF SACCHAROMYCES CEREVISIAE

PARAMETER	T1	T2	T3	T4	T5	SETH
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PH	5.63 b	5.13 b	5.03 b	5.27 b	6.67 a	0.162
Water Holding Capacity	6.00 a	3.33 b	3.33 b	3.67 b	2.00 c	0.360
Cooking Loss Drip Loss	2.00 d	3.33 c	3.33 c	4.00 b	6.00 a	0.371

Meat Colour

The distribution of meat colour categories differed significantly among treatments (P = 0.0032; Table 4). Control birds (T1) exhibited predominantly pale meat, whereas yeast-supplemented groups showed a shift towards pink and white colouration, with T5 producing exclusively white meat samples.

Meat colour is influenced by muscle pH, myoglobin content and oxidative stability (Petracci et al., 2015). The higher pH observed in T5 may have contributed to altered light scattering and colour expression.

However, previous studies have reported minimal influence of *S. cerevisiae* on poultry meat colour. Pelicano et al. (2005) observed no significant changes in colour parameters at 2% yeast inclusion. Similarly, Sharif et al. (2018) and Sun and Kim (2019) reported no major effects on colour traits in broilers. The variation observed in the present study may therefore reflect genotype-specific responses or differences in production environment.

Importantly, none of the treatments exhibited abnormal dark, firm and dry (DFD) or pale, soft and exudative (PSE) conditions, suggesting that yeast supplementation did not induce undesirable colour defects.

Table 4: COLOUR OF NOILER CHICKEN FED DIETS CONTAINING SUPPLEMENTAL LEVELS OF SACCHAROMYCES CEREVISIAE

Diet	Pale	Pink	White	Row Total
T1	3	0	0	3
T2	0	1	2	3
T3	0	1	2	3
T4	0	1	2	3
T5	0	0	3	3
Column Total	3	3	9	15
P-Value				0.0032

Meat Tenderness

Tenderness evaluation (Table 5) revealed significant differences (P = 0.0496) among treatments. Birds fed 1.5% *S. cerevisiae* (T4) produced meat classified as tender, whereas other treatments were predominantly rated as moderately tender.

Tenderness is influenced by muscle fibre diameter, connective tissue characteristics and post-mortem proteolysis (Mir et al., 2017). The improved tenderness at 1.5% inclusion may be associated with enhanced protein turnover or antioxidative protection mediated by yeast β-glucans and bioactive metabolites. Yeast supplementation has been reported to improve muscle integrity and oxidative stability, potentially influencing sensory traits (Elghandour et al., 2020).

Although most treatments exhibited moderate texture, all samples were considered acceptable for consumption, indicating that yeast inclusion did not negatively affect palatability.

Table 5: MEAT TENDERNESS OF NOILER CHICKEN FED DIETS CONTAINING SUPPLEMENTAL LEVELS OF SACCHAROMYCES CEREVISIAE

Diet	Moderate	Tender	P-Value
T1	3	0	0.0496
T2	3	0	
T3	3	0	
T4	0	3	
T5	3	0	

Proximate Composition of Meat

The proximate composition of breast meat (Table 6) showed significant (P < 0.05) differences in dry matter, moisture, ash and crude protein contents.

Crude protein was highest in birds fed 1.0% yeast (T3; 75.06%), followed by T4 (68.18%), while T1 and T5 recorded lower values. This suggests improved protein deposition at moderate supplementation levels, possibly due to enhanced nutrient utilisation and gut health associated with yeast probiotics (Elghandour et al., 2020; Abdel-Rahman et al., 2022).

Ash content was also highest in T3, indicating improved mineral deposition, which may reflect enhanced nutrient absorption. Ether extract did not differ significantly among treatments, suggesting that yeast supplementation did not markedly alter intramuscular fat content.

The increase in crude protein and mineral content at 1.0–1.5% inclusion indicates improved carcass quality and nutrient retention efficiency. These findings align with reports that yeast supplementation enhances amino acid utilisation and protein accretion in poultry (Alagawany et al., 2023).

Metabolisable energy values varied significantly, with higher values observed in T3 and T4, further supporting the hypothesis that moderate yeast inclusion enhances nutrient efficiency.

TABLE 6: PROXIMATE ANALYSIS OF NOILER CHICKEN MEAT FED DIETS CONTAINING SUPPLEMENTAL LEVELS OF SACCHAROMYCES CEREVISIAE

PARAMETER	T1	T2	T3	T4	T5	SEM
Dry matter	92.75 ^a	92.61 ^b	92.46 ^c	92.58 ^a	92.80 ^a	0.051
Moisture	7.25 ^d	7.39 ^c	7.54 ^b	7.62 ^a	7.20 ^d	0.081
Ash/mineral	6.53 ^d	7.61 ^c	8.74 ^a	7.91 ^b	7.21 ^c	0.199
Crude protein	60.12 ^d	63.75 ^c	75.06 ^a	68.18 ^b	61.50 ^d	1.46
Ether Extract	6.54 ^a	6.48 ^a	6.70 ^a	6.48 ^a	6.40 ^a	0.031
Crude fibre	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen fibre Extract	19.57 ^c	14.77 ^e	19.97 ^a	19.81 ^b	17.63 ^d	1.696
Metabolizable Energy	3298.91 ^c	3241.74 ^a	3353.13 ^a	3310.53 ^b	3288.97 ^c	11.19

Conclusion

Collectively, the results indicate that dietary *Saccharomyces cerevisiae* modulated post-mortem muscle characteristics, proximate composition and organoleptic properties of Noiler chicken meat. Moderate supplementation levels (1.0–1.5%) improved crude protein content, mineral deposition and tenderness without adversely affecting colour or technological quality traits. Conversely, 2.0% inclusion increased muscle pH and cooking loss, suggesting that excessive supplementation may alter muscle water dynamics.

These findings demonstrate that optimal yeast inclusion enhances meat quality and sensory acceptability in dual-purpose tropical genotypes, contributing to improved consumer preference and market value.

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