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# Effects of Probiotic (*Saccharomyces cerevisiae*) on Growth Rate and Apparent Nutrient Digestibility in Pullets Fed Palm Kernel Based Diet

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## Abstract

This study investigated the effects of probiotic (Saccharomyces cerevisiae) supplementation on apparent nutrient digestibility and growth rate of pullets fed palm kernel cake-based diets. A total of 100 pullets were randomly divided into 4 groups (A - D) of 25 birds each. Each group was further divided into 5 replicates of 5 birds each (n = 5). Feed for groups B to D contained probiotic at different levels of 0.6, 0.8 and 1.0 g/kg feed respectively. Diet for group A had no probiotic (control). They were fed 100 g/bird/day. Water was given ad libitum. All the experimental birds were weighed every week. At the 10th week, 5 pullets (one from each replicate) were randomly selected from each group and placed in cages where the quantity of feed consumed, and faeces voided were determined. The birds were allowed 4 days to acclimatize in the cage. Thereafter, the faeces from each group were collected every other day for 10 days. The feed and faeces were proximately analyzed. There were significant differences ($p \leq 0.05$) in the weight gain between probiotic supplemented groups and the control. At the 10th week, groups C and D (0.946 ± 0.016 and 0.914 ± 0.041kg/bird respectively) were significantly ($p \leq 0.05$) heavier than groups B and A (0.866 ± 0.033 and 0.856 ± 0.013 kg/bird respectively). The results also showed significant differences ($p \leq 0.05$) in the apparent digestibility of dry matter, organic matter, crude protein and crude fibre between probiotic supplemented groups (B, C and D) and the control. Dry matter digestibility was significantly ($p \leq 0.05$) higher in group D (68.32 ± 1.54%) than group A (57.77 ± 0.87%). The experiment showed that inclusion of live yeast (probiotic) in the diet of pullets increased both apparent digestibility and growth rate. The probiotic supplementation level of 1.0 g/kg of diet was recommended for maximum digestibility and optimum growth rate in pullets fed palm kernel cake-based diets.

***Keywords:*** *Pullets; Feed; Probiotic; Growth Rate; Apparent Digestibility*

## Introduction

In Nigeria, there is decreasing animal protein intake due to over population and poverty, and this necessitates a radical approach to livestock production. In the past 35 years, poultry has been adjudged the highest in the percentage rate of meat production among other livestock [1]. Poultry meat produced was 21 million tonnes higher than beef and veal production (FAO, 2005). Growth in poultry meat production has occurred due to continuous improvement in productivity, genetics and nutritional development. The major constraints in poultry production are nutrition and diseases. To reduce the cost in poultry diet cost without adverse effect on productivity, researchers continue to make efforts to utilize cheaper and readily available feedstuff such as palm kernel cake (PKC) [2-4]. However, Dolberg., *et al.* [5] reported that PKC should be treated for better utilization by poultry. Biotechnological options are available for enhancing the nutritive value of agro-industrial by-products such as PKC [6]. The biotechnological treatment to improve the digestibility of fibrous agricultural by-products includes either the direct use of microorganisms or microbial enzymes [7]. Addition of live yeast to animal feed has been proven to improve the nutritive quality of feed and performance of animals [8,9].

## Objectives of the Study

The objectives of the study were to determine the effects of this probiotic (*S. cerevisiae, SC*) on apparent digestibility, growth rate of pullets and ascertain the optimum level of the probiotic inclusion for maximum productive performance.

## Materials and Methods

The experiment was conducted at the poultry unit, Veterinary farm, University of Nigeria, Nsukka.

### Experimental birds/design

A total of 100 one-day-old pullets (Dominion breed) were procured from Fidan hatchery Ibadan, Nigeria. The chicks were brood together for 4 weeks. Thereafter, they were randomly divided into 4 groups (A - D) of 25 pullets each. Each group was further subdivided into 5 replicates of 5 pullets each. Feed for groups B to D contained probiotic at different levels of 0.6, 0.8 and 1.0 g/kg of experimental diet respectively, while Group A the control had no probiotic in the feed.

### Experimental diets

The partial nutrient composition of feedstuffs used in the experimental diets is shown in table 1. While the percentage composition of the experimental diets (started, grower and layers' mash) and level of *SC* supplementation are presented in tables 2 and 3 respectively.

| Ingredient | Crude Protein (%) | Crude fibre (%) | Metabolizable Energy (kcal/kg) |
|---|---|---|---|
| Maize | 9.0 | 2.0 | 3434.0 |
| Palm kernel cake (PKC) | 15.0 | 20.4 | 3000.0 |
| Soybean meal | 42.0 | 6.5 | 2700.0 |
| Fish meal | 65.0 | 1.0 | 2860.0 |
| Wheat offal | 17.0 | 8.5 | 1870.0 |

***Table 1:*** *Partial nutrient composition of feedstuffs used in the experimental diets.*

| Ingredients | Group A 0.00g SC | Group B 0.60g SC | Group C 0.80g SC | Group D 1.00g SC |
|---|---|---|---|---|
| Maize | 32.00 | 32.00 | 32.00 | 32.00 |
| PKC | 25.00 | 25.00 | 25.00 | 25.00 |
| Soybean meal | 12.00 | 12.00 | 12.00 | 12.00 |
| Fish meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Wheat offal | 18.50 | 17.90 | 17.70 | 17.50 |
| Bone meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Limestone | 1.00 | 1.00 | 1.00 | 1.00 |
| Probiotic | 0.00 | 0.60 | 0.80 | 1.00 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 |
| Lysine | 0.30 | 0.30 | 0.30 | 0.30 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Premix (trace minerals and vitamins A, B complex, D, E and K) | 0.50 | 0,50 | 0.50 | 0.50 |
| Total | 100 | 100 | 100 | 100 |

***Table 2:*** *Percentage composition of experimental diets and level of probiotic (Starter, Mash).*

| Ingredients | Group A 0.00g SC | Group B 0.60g SC | Group C 0.80g SC | Group D 1.00g SC |
|---|---|---|---|---|
| Maize | 40.00 | 40.00 | 40.00 | 40.00 |
| PKC | 25.00 | 25.00 | 25.00 | 25.00 |
| Soybean meal | 4.00 | 4.00 | 4.00 | 4.00 |
| Fish meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Wheat offal | 18.50 | 17.90 | 17.70 | 17.50 |
| Bone meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Limestone | 1.00 | 1.00 | 1.00 | 1.00 |
| Probiotic | 0.00 | 0.60 | 0.80 | 1.00 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 |
| Lysine | 0.30 | 0.30 | 0.30 | 0.30 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Premix (trace minerals and vitamins a, B complex, D, E and K) | 0.50 | 0,50 | 0.50 | 0.50 |
| Total | 100 | 100 | 100 | 100 |

***Table 3:*** *Percentage composition of experimental diets and level of probiotic (Grower, Mash).*

The nutrients content of the experimental diets was determined by proximate analysis using the method described by A.O.A.C [10] and presented in table 4.

### Feeding management

Feeds were given *ad libitum* during the first 4 weeks of age. Thereafter, feeding was restricted to 50 g/bird/day at the 5$^{th}$ week and this gradually increased to 100 g/bird/day at the 10$^{th}$ week. The birds were maintained on this ration until the 16$^{th}$ week when feed was increased to 110 g/bird/day. Water was given *ad libitum*. The birds were weighed weekly.

### Digestibility study

At the 10$^{th}$ week, 5 pullets were randomly selected from each group (1 from each replicate) and placed in cages. The birds were allowed 4 days to acclimatize in the cage, thereafter, the faeces voided by each bird in each group were collected every other day for 10 days. Feed and faeces were processed for proximate analysis following the standard procedure [10]. The proximate fractions were used to determine apparent digestibility coefficient using the procedure of Crampton and Harris [11].

### Data analysis

Results of the weekly weight were analyzed with Repeat Measure analysis of variance (ANOVA). Apparent digestibility coefficients were analyzed using one-way ANOVA. Group means were compared using new Duncan's multiple range tests. All the analyses were performed with SPSS windows 15.0. Level of significance was accepted at $p \leq 0.05$.

## Results and Discussion

Results of the proximate analysis of the experimental diets are shown in table 4. These are normal chick and grower mash.

| Nutrients | Chick Mash | Grower Mash |
|---|---|---|
| Dry Matter (%) | 85.00 | 88.25 |
| Moisture (%) | 15.00 | 11.75 |
| Crude Protein (%) | 17.85 | 15.05 |
| Crude Fibre (%) | 8.26 | 8.12 |
| Ether Extract (%) | 1.55 | 3.25 |
| Ash (%) | 6.55 | 2.35 |
| Metabolizable Energy (kcal./kg) | 2840.14 | 2750.08 |

***Table 4:*** *Results of proximate analysis of the experimental diets.*

Data on mean weekly body weight of pullets are presented in table 5. There were significant differences ($p \leq 0.05$) in weekly weight gain between the probiotic supplemented groups (B, C and D) and group A (control) up to the 10$^{th}$ week of age. Mean weight at 10$^{th}$ week were 0.866 ± 0.033, 0.946 ± 0.016, 0.914 ± 0.041 and 0.856 ± 0.013 kg/bird for groups B, C, D and A respectively. After the 10$^{th}$ week, there was no significant difference ($p > 0.05$) in weekly weight gain until point-of-lay.

| Age (Weeks) | Group B (0.6 g/kg) | Group C (0.8 g/kg) | Group D (1.0 g/kg) | Group A (No Probiotic) |
|---|---|---|---|---|
| 5 | 0.356 ± 0.015 | 0.368 ± 0.011 | 0.360 ± 0.005 | 0.360 ± 0.005 |
| 6 | 0.470 ± 0.009$^{ab}$ | 0.494 ± 0.004$^{a}$ | 0.466 ± 0.006$^{b}$ | 0.468 ± 0.012$^{b}$ |
| 7 | 0.558 ± 0.012$^{ab}$ | 0.582 ± 0.145$^{a}$ | 0.566 ± 0.015$^{ab}$ | 0.544 ± 0.004$^{b}$ |
| 8 | 0.680 ± 0.0.014$^{a}$ | 0.730 ± 0.017$^{b}$ | 0.684 ± 0.016$^{a}$ | 0.680 ± 0.009$^{a}$ |
| 9 | 0.806 ± 0.037 | 0.946 ± 0.016 | 0.808 ± 0.026 | 0.856 ± 0.018 |
| 10 | 0.866 ± 0.033$^{ab}$ | 0.946 ± 0.016$^{a}$ | 0.914 ± 0.041$^{ab}$ | 0.856 ± 0.013$^{b}$ |
| 11 | 1.048 ± 0.019 | 1.054 ± 0.023 | 1.058 ± 0.020 | 1.012 ± 0.016 |
| 12 | 1.192 ± 0.030 | 1.200 ± 0.022 | 1.184 ± 0.019 | 1.166 ± 0.019 |
| 13 | 1.244 ± 0.033 | 1.238 ± 0.041 | 1.404 ± 0.044 | 1.226 ± 0.036 |
| 14 | 1.266 ± 0.021 | 1.278 ± 0.029 | 1.274 ± 0.014 | 1.236 ± 0.013 |
| 15 | 1.316 ± 0.036 | 1.344 ± 0.015 | 1.344 ± 0.004 | 1.296 ± 0.016 |
| 16 | 1.356 ± 0.035 | 1.388 ± 0.040 | 1.390 ± 0.033 | 1.300 ± 0.020 |
| 17 | 1.416 ± 0.024 | 1.468 ± 0.034 | 1.476 ± 0.022 | 1.404 ± 0.044 |

***Table 5:*** *Mean body weight (kg/bird) of pullets ± SE.*

*Different superscripts a, ab, b in a row indicates significant difference ($p \leq 0.05$) between the means of the body weight of the experimental groups.*

Table 6 shows the weight gain, feed intake, feed conversion ratio and feed efficiency. The feed intake is one and the same, because the feeding is limited, but feed conversion ratio was influenced positive by the supplement - FCR is least in group D (7.275) followed by group C (7.382) and highest in group A (7.778). Thus, efficiency of feed utilization was highest in group D (13.744%) followed by group C (13.547%) while group A (control) was the least (12.857%).

| Groups/Parameters | Group A (0.0 g/kg) | Group B (0.6 g/kg) | Group C (0.8 g/kg) | Group D (1.0 g/kg) |
|---|---|---|---|---|
| Initial Body Weight, kg | 0.360 **±** 0.005 | 0.356 **±** 0.015 | 0.368 **±** 0.011 | 0.360 ± 0.005 |
| Final Body Weight, kg | 1.404 **±** 0.044 | 1.416 **± 0.024** | 1.468 **± 0.034** | 1.476 **± 0.022** |
| Weight Gain, kg | 1.044 ± 0.039 | 1.060 ± 0.009 | 1.100 ± 0.013 | 1.116 ± 0.017 |
| Feed Intake (kg/bird) | 8.120 | 8.120 | 8.120 | 8.120 |
| Feed Conversion Ratio (FCR) | 7.778 | 7.660 | 7.382 | 7.275 |
| Feed Efficiency (%) | 12.857 | 13.054 | 13.547 | 13.744 |

***Table 6:*** *Effect of Saccharomyces cerevisiae on the zootechnical performance in pullets.*

Results of apparent digestibility coefficients are presented in table 7. There were significant differences (p≤0.05) in apparent digestibility of the nutrients between the supplemented groups and the control. Dry matter digestibility was highest in group D (68.32% ± 1.54) and lowest in group A (57.77% ± 0.87) the control. Apparent digestibility of organic matter and crude fibre were highest in group C at 49.64% ± 2.16 and 45.67% ± 0.64, respectively and lowest in group A at 34.78% ± 0.82 and 28.38% ± 0.37, respectively. Crude protein digestibility was high in groups C and D at 45.41 ± 0.66% and 42.78 ± 0.41%, respectively and low in group A (27.98 ± 0.40%).

| Coefficient of digestibility, % | Group B (0.6g/kg) | Group C (0.8g/kg) | Group D (1.0g/kg) | Group A (No Probiotic) |
|---|---|---|---|---|
| DM | $66.79 \pm 2.18^{a}$ | $67.99 \pm 2.42^{a}$ | $68.32 \pm 1.54^{a}$ | $57.77 \pm 0.87^{b}$ |
| OM | $45.77 \pm 2.19^{b}$ | $49.64 \pm 2.16^{a}$ | $46.62 \pm 1.58^{b}$ | $34.78 \pm 0.82^{c}$ |
| CP | $39.91 \pm 0.92^{c}$ | $45.41 \pm 0.66^{a}$ | $42.78 \pm 0.41^{b}$ | $27.98 \pm 0.40^{d}$ |
| CF | $40.09 \pm 0.85^{b}$ | $45.67 \pm 0.64^{d}$ | $42.15 \pm 0.48^{c}$ | $28.38 \pm 0.37^{a}$ |

***Table 7:*** *Effect of Saccharomyces cerevisiae on the apparent digestibility of nutrients in pullets.*

*DM: Dry matter, OM: Organic matter.*

*different superscripts a, b, c, d in a row indicates significant difference (p ≤ 0.05) between the means of the body weight of the experimental groups.*

There was significant ($p < 0.05$) positive correlation between weekly weight gain and apparent digestibility of the nutrients. Groups C and D that had the highest apparent digestibility coefficients also recorded the highest weight gain. Ajuwon [12] noted that the mechanisms of probiotic stimulation of growth performance are very complex. He further stated that the modes of action include increasing nutrient availability and increasing volatile fatty acid production which are directly absorbed in the hindgut and used as energy source in the tissues. Another mechanism by which probiotics stimulate growth includes their effects in regulating the immune system which leads to suppression of the negative effects of chronic immune activation [13]. In addition, by directly protecting epithelial barriers, probiotics enhance nutrient absorption which may also result in enhanced growth.

The increased digestibility could be due to the activities of digestive enzymes elaborated by the probiotic. These results are in agreement with the report of Numan [14] and Matsui., *et al*. [15] who reported that the probiotic *S. cerevisiae* secrets digestive enzymes which led to increased efficiency of feed utilization. These results were also in agreement with earlier findings by Adejumo., *et al.* [16] and Ezema [17] who separately observed that probiotic supplementation caused increase in weight gain performance. There was no significant difference in weight gain after the $10^{th}$ week. This finding agrees with the report of Oluyemi and Roberts [18] who observed that in pullets at the $10^{th}$ week, there is a shift from physical to reproductive development which leads to sexual maturity.

## Conclusion

In conclusion, the probiotic *Saccharomyces cerevisiae* increased digestibility and efficiency of feed utilization of PKC based diet which led to improved growth rate of the pullets. The probiotic inclusion level of 1.0 g/kg of feed was recommended for optimum digestibility and maximum growth rate in pullets fed PKC based diet.

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