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# Effect of Dietary Xylanase enzyme Supplementation on the Performance of Growing Crossbred Pigs

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## ABSTRACT

A study examined whether xylanase enzyme supplementation could improve performance in growing crossbred pigs fed diets with lower energy content. The experiment used eighteen crossbred pigs (Large White Yorkshire × local pig crosses), 4 months old, divided into three equal groups of six animals each based on average body weight. The pigs were fed according to BIS (2023) standards (18% crude protein, 3170 kcal ME/kg), with the following treatment groups: T0: Standard pig grower diet (Control), T1: Control diet with energy reduced by 100 kcal ME/kg (Negative control) and T2: Negative control diet supplemented with xylanase (100 g/t). The feeding trial was conducted for 60 days during which daily dry matter intake, weekly body weight changes and body weight gain were recorded. The results indicated no significant differences in body weight, body weight gain, feed conversion ratio, or dry matter intake among the groups. The initial and final body weights were similar across all groups and the body weight gain remained consistent. Hence, the supplementation of xylanase did not significantly improve the growth performance in growing crossbred pigs.

**Keywords:** Enzyme supplementation, Feeding, Feed efficiency, Growth, Pig.

## INTRODUCTION

Pigs offer exceptional economic potential compared to other livestock species due to their unique biological advantages like high reproduction rates, superior feed conversion efficiency, quick maturation and short generation intervals allow for faster returns on investment. The pig industry constantly seeks ways to improve feed efficiency while reducing production costs. One key approach involves lowering the energy or nutrient content in diets without compromising performance. The use of exogenous enzymes in these energy-reduced diets represents a promising strategy for maintaining productivity while decreasing feed costs. By supplementing lower-energy diets with specific enzymes, producers may potentially maintain growth performance while using less expensive feed formulations, creating an opportunity to enhance profitability in pig farming operations.

Corn and soybeans are an important feedstuff in pig feeding. Studies indicated that non-starch polysaccharide (NSP) in corn and soybean meal has negative effects on nutrient digestibility (Van Kempen *et al,* 2006). Whole corn grain contains 27–32 g of xylose/kg (Knudsen, 1997) as arabinoxylans in the pericarp and aleurone (Doner *et al*, 2001) which results in decreasing nutritional value of corn . The supplementation of xylanase has been evaluated to improve growth performance and nutrient digestibility in pigs (Cheng *et al*, 2022). Xylanase enzyme supplementation in pig diets has shown promising results in improving feed efficiency and nutrient utilization. This exogenous enzyme specifically targets non-starch polysaccharides like xylans, which are abundant in cereal grains commonly used in pig feed but cannot be effectively broken down by the animal's endogenous enzymes. By hydrolyzing these complex carbohydrates, xylanase reduces intestinal viscosity and enhances the release of nutrients that would otherwise remain trapped within plant cell walls. Research indicates that xylanase supplementation can improve digestibility of energy, protein, and minerals, particularly phosphorus, while potentially reducing environmental pollution through decreased nutrient excretion. So far various research has been conducted to see the effect of supplementation of multi-carbohydrases (Yin and Kim, 2019) in all phases of pig production (Aranda-Aguirre *et al,* 2021), while scientific work addressing supplementation of the xylanase enzymes alone or in combination in the diet of growing pigs fed metabolizable energy-reduced diets are scarce and their mechanisms of action have not been yet established. Hence, the hypothesis in this study was that the supplementation of xylanase

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**Table 1: Ingredient composition (% DM basis) of experimental diets**

| Sr. No. | Ingredient | T0 | T1 | T2 |
|---|---|---|---|---|
| 1 | Maize | 51.1 | 54.0 | 54.0 |
| 2 | Soybean | 20.0 | 20.5 | 20.5 |
| 3 | Rice polish | 13.6 | 14.5 | 14.5 |
| 4 | GNC | 7.0 | 5.0 | 5.0 |
| 5 | Vegetable oil | 4.4 | 2.1 | 2.1 |
| 6 | Trace Mineral/Premix | 2.0 | 2.0 | 2.0 |
| 7 | Salt | 1.0 | 1.0 | 1.0 |
| 8 | Lysine | 0.6 | 0.6 | 0.6 |
| 9 | Methionine | 0.3 | 0.3 | 0.3 |
| 10 | Vitamins/Premix | + | + | + |
| | Total | 100 | 100 | 100 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t.*

**Table 2: Effect of xylanase in low energy density diets on weekly body weight change (kg/pig) in growing crossbred pigs.**

| Age (Weeks) | Control | T1 | T2 | SEM | P Value |
|---|---|---|---|---|---|
| **Initial BW** | 30.60 | 30.97 | 29.57 | 1.32 | 0.984 |
| 1 | 34.94 | 35.14 | 33.79 | 1.43 | 0.984 |
| 2 | 39.46 | 39.01 | 38.28 | 1.49 | 0.99 |
| 3 | 43.53 | 43.13 | 42.27 | 1.59 | 0.994 |
| 4 | 46.02 | 45.52 | 45.10 | 1.57 | 0.998 |
| 5 | 49.63 | 49.32 | 48.90 | 1.57 | 0.999 |
| 6 | 54.15 | 54.20 | 54.17 | 1.65 | 0.998 |
| 7 | 56.73 | 56.73 | 57.20 | 1.70 | 0.999 |
| 8 | 59.96 | 59.50 | 61.50 | 1.76 | 0.984 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t.*

**Table 3: Effect of xylanase supplementation in low energy density diets on weekly body weight gain (kg/pig) in growing crossbred pigs.**

| Age (Weeks) | Control | T1 | T2 | SEM | P Value |
|---|---|---|---|---|---|
| 1 | 4.34 | 4.17 | 4.22 | 0.22 | 0.979 |
| 2 | 4.52 | 3.86 | 4.49 | 0.14 | 0.368 |
| 3 | 4.07 | 4.13 | 3.99 | 0.17 | 0.732 |
| 4 | 2.48 | 2.38 | 2.83 | 0.12 | 0.505 |
| 5 | 3.62 | 3.8 | 3.8 | 0.14 | 0.951 |
| 6 | 4.52 | 4.89 | 5.26 | 0.25 | 0.576 |
| 7 | 2.58 | 2.52 | 3.03 | 0.13 | 0.422 |
| 8 | 3.23 | 2.77 | 4.3 | 0.21 | 0.350 |
| Overall | 3.67 | 3.56 | 3.99 | 0.08 | 0.323 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t.*

**Table 4: Effect of xylanase supplementation in low energy density diets on dry matter intake (kg/pig) in growing crossbred pigs.**

| Age (Weeks) | Control | T1 | T2 | SEM | P Value |
|---|---|---|---|---|---|
| 1 | 1.17 | 1.23 | 1.17 | 0.02 | 0.699 |
| 2 | 1.26 | 1.31 | 1.23 | 0.02 | 0.586 |
| 3 | 1.20 | 1.40 | 1.22 | 0.04 | 0.451 |
| 4 | 1.34 | 1.16 | 1.31 | 0.03 | 0.115 |
| 5 | 1.76 | 1.76 | 1.74 | 0.02 | 0.107 |
| 6 | 1.67 | 1.82 | 1.77 | 0.03 | 0.246 |
| 7 | 1.33 | 1.35 | 1.70 | 0.05 | 0.179 |
| 8 | 1.57 | 1.40 | 1.72 | 0.04 | 0.270 |
| Overall | 1.41 | 1.42 | 1.48 | 0.01 | 0.281 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t,*

**Table 5: Effect of xylanase supplementation in low energy density diets on average daily feed intake (kg/pig) in growing crossbred pigs**

| Age (Weeks) | Control | T1 | T2 | SEM | P Value |
|---|---|---|---|---|---|
| **1** | 1.31 | 1.38 | 1.31 | 0.02 | 0.697 |
| **2** | 1.43 | 1.48 | 1.39 | 0.02 | 0.609 |
| **3** | 1.35 | 1.57 | 1.38 | 0.04 | 0.444 |
| **4** | 1.51 | 1.31 | 1.48 | 0.03 | 0.204 |
| **5** | 1.98 | 1.98 | 1.96 | 0.02 | 0.206 |
| **6** | 1.89 | 2.05 | 2 | 0.03 | 0.255 |
| **7** | 1.5 | 1.52 | 1.91 | 0.05 | 0.214 |
| **8** | 1.76 | 1.58 | 1.94 | 0.04 | 0.261 |
| **Overall** | 1.58 | 1.60 | 1.66 | 0.02 | 0.255 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t,*

**Table 6: Effect of xylanase supplementation in low energy density diets on feed conversion ratio in growing crossbred pigs.**

| Age (Weeks) | Control | T1 | T2 | SEM | P Value |
|---|---|---|---|---|---|
| 1 | 2.33 | 2.44 | 2.21 | 0.13 | 0.952 |
| 2 | 2.27 | 2.71 | 2.19 | 0.08 | 0.123 |
| 3 | 2.41 | 2.73 | 2.42 | 0.08 | 0.528 |
| 4 | 4.36 | 4.02 | 3.9 | 0.17 | 0.442 |
| 5 | 3.87 | 3.73 | 3.8 | 0.14 | 0.753 |
| 6 | 3.01 | 3.06 | 2.73 | 0.14 | 0.852 |
| 7 | 4.67 | 4.25 | 4.43 | 0.25 | 0.941 |
| 8 | 3.95 | 4.31 | 3.28 | 0.21 | 0.268 |
| Overall | 3.36 | 3.40 | 3.12 | 0.07 | 0.600 |

*T0: No supplementation (Basal or Positive control diet), T1: T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet), T2: T1 + xylanase enzyme supplementation @ 100 g/t,* enzymes would allow the reduction of ME in diets, by increasing the use of energy and nutrients and consequently, would support pig performance.

## MATERIALS AND METHODS

### Selection of experimental animals, dietary treatment, and experimental design

Eighteen growing crossbred pigs (irrespective of sex) about 4 months of age pertaining to large white yorkshire crossed with desi pigs, were selected from AICRP on pig unit, Adhartal, College of Veterinary Science and A.H., N.D.V.S.U., Jabalpur (M.P) for the study. The growing crossbred pigs were randomly allotted to three dietary (6 animals each) treatments. The control group (T0) was standard pig grower diet as per BIS (2023) feeding standard (18% CP and 3170 kcal ME/kg diet) (Basal or Positive control diet) with no supplementation. Group T1 was T0 with reduced energy by 100 kcal ME/kg diet (Negative control diet). Group T2 diet included T1 + xylanase enzyme supplementationat a dosage rate of 100 g/t of feed (cost of 1 kg xylanase enzyme: ₹550). The ingredient composition of experimental diets is given in Table 1. The experiment was conducted for 8 weeks where all the pigs was managed under similar conditions.

The growth and feed utilization of experimental crossbred pigs were closely monitored throughout the trial. Daily dry matter intake (DMI) was tracked by recording the difference between feed offered and leftover feed on a weekly basis. This allowed to calculate precise consumption levels for each treatment group. Body weights were recorded weekly from the beginning to the end of the experiment using an electrical weighing balance. To ensure accuracy, weight measurements were taken in the morning before feeding. A 5-day adjustment period preceded the actual experiment to allow animals to acclimate to the experimental conditions. The pigs were housed and fed in groups, receiving measured quantities of feed twice daily—at 9:00 A.M. and 3:00 P.M. Clean drinking water was provided freely around the clock. Individual average feed consumption was determined by dividing the total group feed intake by the number of animals in each group. Feed conversion ratio, a key efficiency measure, was calculated by dividing the total feed consumed by the total body weight gained during the experimental period. Statistical analysis of the data was done by using analysis of variance using a completely randomized design as per Snedecor and Cochran (1994). Differences among the treatments will be tested for significance by Duncan's Multiple Range Test (1955)

## RESULTS AND DISCUSSION

### Growth Performance

The effect of xylanase supplementation on the weekly BW change (Kg) and weekly BW gain (Kg) of growing crossbred pigs is summarized in Table 2 and 3, respectively. The initial BWs in the T0, T1 and T2 groups were 30.60 Kg, 30.97 Kg and 29.57 Kg, respectively. By the end of the study, the BWs in the T0, T1 and T2 groups were 59.96 Kg, 59.50 Kg and 61.50 Kg, respectively.T2 Group crossbred pigs which were fed with marginal deficient in energy diet supplemented with enzyme xylanase their body weight improved and reached better than the positive and negative control pigs'group with normal ME for pigs. The initial weekly BW gain in the T0, T1 and T2 groups were 4.34 Kg, 4.17 Kg and 4.22 Kg, respectively. By the end of the feeding trial, the overall weekly BW gain for the T0, T1 and T2 groups were 3.67 Kg, 3.56 Kg and 3.99 Kg, respectively. Statistical analysis revealed no significant differences in the weekly BW gain among the groups ($P>0.05$).

During the 1$^{st}$ week, the DMI in the T0, T1 and T2 groups was 1.17 Kg/day, 1.23 Kg/day, 1.17 Kg/day, respectively, while, 8$^{th}$ week, T2 had a significantly ($p<0.05$) higher DMI 1.72 kg/day, followed by T0 which 1.56 kg/day while T1 recorded the lowest intake 1.40 kg/day.The overall DMI across the 8 weeks for the T0 (control), T1, and T2 groups was 1.41 kg/day, 1.42 kg/day, and 1.48 kg/day, respectively (Table 4). Overall (8 weeks) results indicated that when growing crossbred pigs were fed with low energy density diet supplemented with xylanase100g/ t, did not influence the dry matter intake and therefore dry matter intake (kg/ pig) were statistically ($p>0.05$) similar in all the groups.

The effect of xylanase supplementation on the ADFI (Kg) and FCR of growing crossbred pigs is summarized in Table 5 and 6, respectively. During the study, no significant ($P>0.05$) differences were observed in the ADFI among the groups. In the 1$^{st}$ week, T1 exhibited the highest average daily feed intake 1.38 kg, followed by the control group 1.31 and T2 1.31 kg and by the overall, the ADFI for the control, T1 and T2 groups was 1.58 Kg/day, 1.60 Kg/day and 1.66 Kg/day, respectively. Overall (8 weeks) results of study indicated that when growing crossbred pigs were fed with low energy density diet supplemented xylanase 100 g/t did not influence their average daily feed intake and therefore average daily feed intake (kg/pig) were statistically ($p>0.05$) similar in all the groups.The mean FCR across all weeks for the control, T1 and T2 was 3.36, 3.40 and 3.12, respectively. The FCR values remained consistent across all dietary treatments, indicating no substantial impact from the supplements. Similarly, results were also reported by Baker *et al* (2024), who found no significant effect of reducing energy by 100 kcal ME/kg or supplementing with β-mannanase in diets containing xylanase-phytase on body weight but highlighted improvements in nutrient digestibility. In the same manner, studies by Barrera *et al* (2004) and Cho *et al* (2013) reported that enzyme supplementation, particularly xylanase, improved body weight, body weight gain and growth performance, mainly by enhancing nutrient utilization. In this study, the trend of higher body weights in enzyme-supplemented groups suggests that xylanase could help support growth performance, especially in pigs on reduced energy diets, by improving nutrient digestibility and absorption. Although the statistical differences were not significant, the observed trends are promising and indicate that enzyme supplementation could be a useful strategy to optimize growth performance in energy-restricted diets.

Agyekum *et al* (2015) and Diebold *et al* (2004) reported by no significant ($p<0.05$) changes in ADFI were observed across the treatments in several weeks. T2 exhibiting higher ADFI in the 7$^{th}$ and 8$^{th}$ weeks, consistent with Cho *et al*. (2013) and Bharathidhasan *et al* (2010), who noted that enzyme supplementation could enhance feed intake by improving nutrient utilization. The enzyme supplementation did not consistently affect feed intake but showed improvements at specific time points, suggesting that xylanase may enhance nutrient digestion without major alterations in overall feed consumption. McAlpine *et al*. (2012), observed no significant improvements in feed conversion efficiency with enzyme supplementation. T2 showed the most favourable FCR overall,despite the lack of consistent statistical significance,improved FCR was observed in certain weeks in T2 group, supporting the findings of Paterson *et al* (2005), who found that enzyme supplementation helps improve digestion and nutrient availability by reducing intestinal viscosity. Galli *et al* (2024) further emphasized that improvements in nutrient digestibility and metabolizable, which could result from enzyme supplementation, can contribute to better feed conversion.

These results align with the findings of the current study, suggesting that supplementing xylanase had no significant impact on the growth performance of growing crossbred pigs. The lack of notable differences in growth performance parameters may be attributed to the lower dosage levels of these enzymes, which were likely insufficient to produce a measurable effect. Further research exploring different dosages and enzyme combinations is necessary to gain a clearer understanding of their potential benefits.

## CONCLUSION

The dietary supplementation xylanase (@100g/tonn) in low-energy diets can enhance the growth performance and feed efficiency of growing crossbred pigs. Xylanase showed the most improvements in body weight gain, feed conversion ratio. Further research exploring different dosages and enzyme combinations is necessary to gain a clearer understanding of their potential benefits.

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