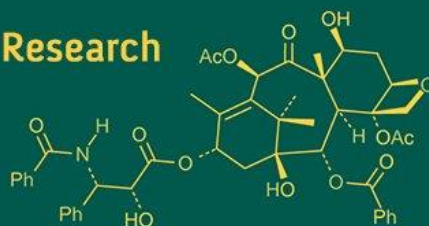


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Effect of xylanase and β -mannanase supplementation in energy-reduced diets on biochemical parameters and economic performance of weaner crossbred pigs

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Abstract

The present study was conducted to investigate the impact of xylanase and β -mannanase supplementation on performance of weaner crossbred pigs fed on reduced energy diets, 24 weaner crossbred pig (irrespective of sex) around 2 months of age were divided into four experimental groups with 6 pigs in each group based on body weight. Experimental pigs were fed standard pig weaner diet as per BIS (2023) feeding standard. Where T₀ group received basal diet (standard pig weaner diet as per BIS, 2023), T₁ group received diet containing reduced energy by 100 kcal ME/kg of T₀ diet (negative control group), T₂ group received diet as T₁ group along with xylanase enzyme supplementation (@ 100 g/ton), T₃ group received diet as T₁ along with β -mannanase enzyme supplementation (@ 100 g/ton). Total experimental period was 60 days. Serum biochemical parameters including SGPT, SGOT, total protein, albumin, BUN and creatinine of weaner crossbred pigs. The results revealed no significant ($p > 0.05$) differences among the treatment groups for all biochemical parameters, indicating that inclusion of xylanase and β -mannanase did not adversely affect protein metabolism or physiological status of weaner crossbred pigs. Total recurring cost (Rs.) was 4367.43, 4112.36, 4143.39 and 4180.96 in T₀, T₁, T₂ and T₃ groups, respectively. The recurring cost (Rs.)/kg body weight gain was 175.33, 171.49, 153.69 and 147.89 in T₀, T₁, T₂ and T₃ groups, respectively. Moreover, the use of xylanase and β -mannanase enzyme in reduced-energy diets for weaner crossbred pigs is economical without affecting biochemical parameters.

Keywords: Weaner crossbred pigs, xylanase, β -mannanase, reduced-energy diets, serum biochemical parameters, economic efficiency

Introduction

Price volatility and availability of feedstuffs used in pig feeds drive the need to efficiently use readily available and economically favorable coproducts in formulation. Typically, increased inclusion of coproducts results in an increase in non-starch polysaccharides (NSP) that are not digestible by endogenous enzymes of pigs and thus the supplementation of feed enzymes targeting specific types of NSP has been implemented^[1]. Hence, reducing costs and making pig feed more efficient remains a top priority for the pig industry. One promising approach to increasing pig diets nutritional efficiency involves using exogenous enzymes in ME-reduced diets.

Maize and soybean meal are major feed ingredients used in pig nutrition. However, the presence of non-starch polysaccharides (NSP) in these feedstuffs can negatively affect nutrient utilization and animal performance. Whole maize grain contains approximately 27-32 g/kg of xylose in the form of arabinoxylans located mainly in the pericarp and aleurone layers^[8], which contributes to reduced nutritional value of maize-based diets^[7]. Supplementation of xylanase has been shown to hydrolyze arabinoxylans by targeting the β -1,4-linked xylopyranose backbone of xylan, thereby improving nutrient digestibility and growth performance in pigs^[4].

Similarly, pig diets often contain β -mannan, another NSP that adversely affects digestive physiology and gut function^[5]. Due to the lack of endogenous enzymes capable of degrading α -1,6-galactosyl and β -1,4-mannosyl bonds, β -mannan is poorly digested in pigs^[14]. Exogenous β -mannanase can degrade β -mannan into manno-oligosaccharides and mannose^[6], potentially improving nutrient availability and intestinal health.

Therefore, the present study was evaluating the effects of dietary supplementation of xylanase and β -mannanase, either alone or in combination, in metabolizable energy-reduced diets for weaned pigs. The study specifically aimed to investigate their influence on blood biochemical parameters as well as the economic efficiency of production through assessment of feed cost, cost per kilogram of body weight gain, and overall profitability.

Materials and Methods

The present experiment was conducted at the pig farm, All India Coordinated Research Project (AICRP) on Pig, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh. A total number of 24 weaner crossbred pigs (irrespective of sex) above 2 months of age pertaining to Large White Yorkshire crossed with desi pigs. The weaner crossbred pigs are randomly allotted to four dietary treatments. The dietary treatments consisted of a basal diet T₀-Standard pig grower diet as per BIS (2023) feeding standard (20% CP and 3360 kcal ME/kg diet) (basal or positive control diet) with no supplementation, T₁-T₀ with reduced energy by 100 kcal ME/kg diet (negative control diet), T₂-T₁ + xylanase enzyme supplementation @ 100 g/ton of feed, T₃-T₁ + β -mannanase enzyme supplementation @ 100 g/ton of feed.

Biochemical parameters

Blood samples were collected aseptically, in clot activating vials by ear vein puncture in treatment group on 0th, 30th and 60th day of the experiment. Blood was left to coagulate and centrifuged at 3500 rpm for 15 min, to obtain serum and was stored in serum storage vials at -20 °C until analyzed. Serum biochemical parameters including total protein, albumin, Blood urea nitrogen, Alanine aminotransferase, Aspartate aminotransferase, Creatinine were estimated using standard commercial diagnostic kits.

Economics

Economics of the production of pigs is calculate based on the recurring expenditure incurred during the experimental period.

Statistical analysis

The data obtained were subjected to analysis of one-way ANOVA described by Snedecor and Cochran (1994) ^[12]. Means showing significant differences in the ANOVA table are compare using the Duncan's Multiple Range Test (Stell and Toorie, 1980) ^[13].

Result and Discussion

Biochemical Parameters

Table 1: Effect of xylanase and β -mannanase on serum biochemical parameter of weaner crossbred pigs

Parameter	Day	T ₀	T ₁	T ₂	T ₃
SGPT (U/L)	0	43.31±5.84	36.17±3.98	39.11±3.63	38.77±3.11
	30	40.36±3.99	40.80±4.55	34.62±2.00	32.40±1.13
	60	45.61±3.31	52.55±2.83	53.85±2.72	48.53±3.13
SGOT (U/L)	0	49.10±2.27	47.70±3.73	48.29±2.69	41.12±2.75
	30	43.47±3.71	50.99±5.18	47.09±4.38	50.50±5.02
	60	58.48±3.13	51.91±5.50	55.99±3.25	56.85±4.06
Total protein (g/dL)	0	8.27±0.19	8.24±0.19	8.45±0.17	8.05±0.15
	30	8.21±0.17	8.61±0.18	8.22±0.16	8.45±0.16
	60	8.59±0.17	8.34±0.15	8.34±0.19	8.56±0.19
Albumin (g/dL)	0	2.58±0.16	2.65±0.15	2.92±0.14	2.46±0.18
	30	2.64±0.14	2.59±0.16	2.76±0.18	2.87±0.13
	60	2.35±0.09	2.72±0.16	2.73±0.14	2.61±0.11
BUN (mg/dL)	0	16.34±0.98	16.18±0.86	17.21±1.51	18.37±1.26
	30	19.64±1.71	17.39±1.29	15.65±1.10	18.28±0.99
	60	17.96±1.15	17.41±1.01	18.09±1.00	18.76±1.53
Creatinine (mg/dL)	0	1.31±0.09	1.44±0.09	1.37±0.07	1.50±1.00
	30	1.29±0.06	1.27±0.05	1.19±0.04	1.38±1.00
	60	1.36±0.05	1.39±0.09	1.35±0.06	1.30±0.07

SGPT (U/L)

At day 0, T₀ recorded the highest SGPT concentration (43.31±5.84) as compared to other treatment groups. By day 30, T₁ had the highest SGPT levels (40.80±4.55) as compared to other treatment groups. By day 60, T₂ had the highest SGPT levels (53.85±2.72) as compared to other treatment groups. The SGPT levels in serum were not significantly ($p > 0.05$) different among treatments.

SGOT (U/L)

At day 0, T₀ recorded the highest SGOT concentration (49.10±2.27) as compared to other treatment groups. By day 30, T₁ (reduced diet) had the highest SGOT levels (50.99±5.18) as compared to other treatment groups. By day 60, T₀ had the highest SGOT levels (58.48±3.13) as compared to other treatment groups. The SGOT levels in serum were not significantly ($p > 0.05$) different among

treatment groups.

Total Protein (g/dL)

At day 0, T₂ recorded the highest protein concentration (8.45±0.17) as compared to other treatment groups. By day 30, T₁ had the highest total protein levels (8.61±0.18) as compared to other treatment groups. By day 60, T₀ had the highest total protein levels (8.59±0.17) as compared to other treatment groups. The total protein levels in serum were not significantly ($p > 0.05$) different among treatments.

Albumin (g/dL)

Serum albumin concentrations (g/dL) did not differ significantly ($p > 0.05$) among the treatment. On day 0, T₂ recorded the highest albumin (2.92±0.14) as compared to other treatment groups. On the day 30, T₃ recorded the highest albumin (2.87±0.13) as compared to other treatment

groups. On the day 60, T₂ recorded the highest albumin (2.73±0.14) as compared to other treatment groups.

BUN (mg/dL)

Serum BUN concentrations (mg/dL) did not differ significantly ($p > 0.05$) among the treatment. On day 0, T₃ recorded the highest BUN (18.37±1.26) as compared to other treatment groups. On the day 30, T₀ recorded the highest BUN (19.64±1.71) as compared to other treatment groups. On the day 60, T₃ recorded the highest BUN (18.76±1.53) as compared to other treatment groups.

Creatinine (mg/dL)

Serum creatinine concentrations (mg/dL) did not differ significantly ($p > 0.05$) among the treatment. On day 0, T₃ recorded the highest creatinine (1.50±1.00) as compared to other treatment groups. On the day 30, T₃ recorded the highest creatinine (1.38±1.00) as compared to other treatment groups. On the day 60, T₁ recorded the highest creatinine (1.39±0.09) as compared to other treatment groups.

SGPT and SGOT levels which are the markers of liver function, showed no significant alterations across treatments, indicating no adverse effects on hepatocellular health, Dutta *et al.* (2020) ^[9]. A similar observation is reported by Jo *et al.*, (2012) ^[10], who find that exogenous enzyme supplementation in corn-soybean meal-based diets does not significantly affect blood urea nitrogen and total protein concentrations in growing pigs, supporting the present findings.

A similar result is reported by Lan *et al.*, (2017) ^[11] who observe that xylanase supplementation in corn-soybean meal-based diets for weaning pigs does not significantly affect serum creatinine concentrations among dietary treatments. In relation to the current findings, Ao *et al.* (2011) ^[2] also concluded that supplementing a carbohydrase cocktail in finishing pigs fed palm kernel meal-based diets

did not affect blood profiles, as total protein, creatinine, and blood urea nitrogen concentrations remained similar across all treatments.

Dietary supplementation with xylanase and β -mannanase did not negatively affect the serum biochemical parameters of weaner crossbred pigs. Even though the diet had reduced energy, the enzymes helped maintain normal metabolic health similar to pigs on the control diet.

Economics

The effect of xylanase and β -mannanase supplementation in low-energy diets on the economics of weaner crossbred pigs is presented in Table 02. The cost of feed including supplements (₹/kg) during the experimental period is 35.90, 33.47, 33.56, and 33.54 in T₀, T₁, T₂, and T₃ groups, respectively. The total feed intake (kg) per pig during the experimental period is 95.67, 94.99, 95.64, and 96.83 in T₀, T₁, T₂, and T₃ groups, respectively. The total feed cost (₹) in weaner crossbred pigs is 3434.10, 3179.03, 3210.06, and 3247.62 in T₀, T₁, T₂, and T₃ groups, respectively. During the experimental period, the total weight gain (kg) in weaner crossbred pigs in T₀, T₁, T₂, and T₃ groups is 24.91, 23.98, 26.96, and 28.27, respectively. The cost of feed (₹) per kg body weight gain is 137.86, 132.57, 119.07, and 114.88 in T₀, T₁, T₂, and T₃ groups, respectively. The percentage decrease in feed cost per kg body weight gain compared to the control group (T₀) is 5.29, 18.79, and 22.98 in T₁, T₂, and T₃ groups, respectively. The total recurring cost is 4367.43, 4112.36, 4143.39, and 4180.96 in T₀, T₁, T₂, and T₃ groups, respectively. The recurring cost (₹)/kg body weight gain is 175.33, 171.49, 153.69, and 147.89 in T₀, T₁, T₂, and T₃ groups, respectively.

The study shows that supplementation of xylanase and β -mannanase in low-energy diets improves the economic efficiency of weaner crossbred pig production by reducing recurring production costs.

Table 2: Effect of xylanase and β -mannanase supplementation in low energy density diets on economics of production of weaner crossbred pigs

Particulars	Groups			
	T ₀	T ₁	T ₂	T ₃
Feed cost including supplements (₹ per kg)	35.90	33.47	33.56	33.54
Total feed intake (kg)	95.67	94.99	95.64	96.83
Total feed cost (₹)	3434.10	3179.03	3210.06	3247.62
Total weight gain (kg)	24.91	23.98	26.96	28.27
Cost of feed (₹/kg) body weight gain	137.86	132.57	119.07	114.88
Decrease of feed cost (₹) per kg body weight gain in comparison to control group	-	5.29	18.79	22.98
% decrease of feed cost per kg body weight gain	-	3.84	13.63	16.67
Labour cost (₹) [24 pigs/labour, labour cost @ ₹10000/month] for 2 months	833.33	833.33	833.33	833.33
Miscellaneous cost (₹) [@ 50/month] for 2 months	100.00	100.00	100.00	100.00
Total recurring cost (₹)	4367.43	4112.36	4143.39	4180.96
Recurring cost (₹)/kg body weight gain	175.33	171.49	153.69	147.89

Conclusion

The present study revealed that xylanase (@ 100 g/ton) and β -mannanase (@ 100 g/ton) supplementation in low-energy diets no adverse effect on biochemical parameters on weaner crossbred pigs. The economic analysis indicates that xylanase and β -mannanase enzymes supplementation, particularly β -mannanase, provides a cost-effective strategy for improving pig production in low-energy diets. Energy level can be reduced in weaner crossbred pigs diet by 100kcal ME/kg than standard by supplementing their diets with xylanase (@ 100 g/ton) and β -mannanase (@ 100 g/ton) without any adverse effect on weaner crossbred pigs

for economical pig production. Overall, it can be concluded that xylanase and β -mannanase (@ 100 g/ton) can be supplementation in weaner crossbred pigs diet cost of production without affecting biochemical parameters.

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