



Effect of dietary supplementation of certain enzymes on growth performance and feed conversion efficiency in Yorkshire piglets

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Carbohydrates are considered to be very effective in diets of young pigs due to their poor digestive capability (Nortey *et al.* 2007). Proteases and lipases help in digesting proteins and lipids, usually that are resistant to the native digestive enzymes of intestine of piglets. Phytase supplementation in pig diets enhances the availability of phosphorous, addition of which in pig diets is a common practice in developed countries (Augspurger *et al.* 2007). Sheppy (2001) reported that, besides enhancing the utilization of nutrients, the exogenous enzymes inactivate the anti-nutritional factors apart from supplementing the endogenous enzymes action. Therefore, the present experiment was conducted to evaluate a cocktail of enzymes on growth performance, feed conversion ratio and economics by feeding high fibre and low energy diet in comparison with the low fibre and high energy diet in Yorkshire piglets.

Large White Yorkshire piglets (18), 75±1.82 day-old and weighing 23.44±0.44 kg were purchased commercially and assigned randomly to 1 of 3 treatment diets (6 piglets/treatment diet) for 91 days. All the piglet groups were kept separately under hygienic conditions in well ventilated sty (4 m × 3 m) having cemented concrete non slippery floor. Deworming was done to all animals at the beginning of the experiment. Healthy surroundings and proper cleanliness were maintained in the experimental sheds.

The experimental diets (Table 1) were formulated using corn-soybean meal. The test diets were positive control (PC; n, 6), negative control (NC; n, 6), and negative control diet supplemented with cocktail of enzymes (ENC; n, 6). The test diets were formulated to have 18% CP (DM basis) to meet the piglets' requirements, and metabolizable energy (ME) was calculated based on standard values for feed

Table 1. Ingredients and enzyme composition of the experimental diets

Item	Experimental diets		
	PC	NC	ENC
<i>Ingredients (g/kg DM)</i>			
Maize	581.70	400.00	400.00
Soya bean meal	236.80	218.50	218.50
De-oiled rice bran	150.00	350.00	350.00
Common salt	5.00	5.00	5.00
Mineral mixture ^a	25.00	25.00	25.00
L-Lysine	1.00	1.00	1.00
Vitamins AB ₂ D ₃ K	0.25	0.25	0.25
B complex vitamins	0.25	0.25	0.25
<i>Enzyme concentration (IU/kg)</i>			
Cellulase	-	-	3000
Xylanase	-	-	5200
Protease	-	-	4000
Lipase	-	-	1500
Phytase	-	-	1500
Pectinase	-	-	2500
Hemicellulase	-	-	3000
Amylase	-	-	1500
β-mannanase	-	-	2800
β-glucanase	-	-	3000
Cellulase	-	-	3000
Xylanase	-	-	5200
Feed cost/tonnes (₹)	14470.00	13580.00	14080.00

^aMineral supplement was added @ 10 g/100 kg diet and composition per 1 kg contained (Mn, 10.9 g; I, 1.09 g; Zn, 22.73 g; Fe, 22.73 g; Cu, 2.73 g; Co, 0.635; Mg, 100 g; Se, 0.1g).

ingredients according to NRC (1988). Feeding of animals lasted for 91 days. The treatment diets (PC, NC and ENC) were offered to the piglets twice a day (2 equal meals at 09:00 and 15:00 h) with free access to clean, fresh and wholesome drinking water for the duration of the study. Feed samples and residues were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and total ash (AOAC 1997). The cost of test diets (₹) was worked

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Table 2. Chemical composition of the experimental diets

Item Nutrient (g/kg DM)	Experimental diets		
	PC	NC	ENC
Dry matter	890.00	895.90	895.90
Crude protein	186.00	182.00	182.00
Crude fibre	44.80	67.00	67.00
Ether extract	12.00	13.10	13.10
Total ash	46.40	48.60	48.60
ME (Kcal/kg DM) ^a	2800.00	2500.00	2500.00

^aME: metabolizable energy; calculated using NRC (1988).

Table 3. Least square means for intake, growth performance and feed conversion ratio of Yorkshire piglets fed experimental diets

Item	Experimental diets			
	PC	NC	ENC	SEM
Dry matter intake (g/day)	1677.92 ^b	1596.13 ^a	1591.83 ^a	12.29
Growth performance				
Initial body weight (kg)	23.50	23.50	23.33	0.36
Final body weight (kg)	70.00 ^b	61.67 ^a	68.67 ^b	0.94
Total gain (kg)	46.50 ^{ab}	38.33 ^a	56.35 ^b	2.53
ADG (g) ¹	258.33 ^{ab}	212.96 ^a	313.06 ^b	14.08
FCR ²	6.50 ^a	7.53 ^b	6.32 ^a	0.56
Cost/kg gain (Rs)	93.99 ^b	102.22 ^c	88.99 ^a	0.08

^a, ^b, ^c Means with different superscripts row-wise differ significantly ($P < 0.01$).¹ ADG, average daily gain ((final weight–initial weight)/91 days); ² FCR (g DM intake/g ADG), feed conversion ratio.

out taking prevailing market rates of all the ingredients and enzymes into consideration and cost incurred on different pig diets was arrived by calculating their feed intake/day.

Data were analyzed according to Snedecor and Cochran (1994). Analysis of variance (ANOVA) was utilized to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan's multiple-range and F Test (Duncan 1955).

Live weight gain in piglets: Least square means of DM intake in piglets fed diets containing enzymes are presented in Table 3. A tendency was detected ($P < 0.01$) for DM intake to be lower for the NC and ENC groups compared to PC group, while similar intakes in enzyme supplemented and control group of piglets were reported by Lee *et al.* (2001). Initial and final body weights, total gain, ADG are shown in Table 3. At the beginning of the study, average initial body weight was similar among treatment groups. The final weight, total gain and ADG were significantly ($P < 0.01$) higher on ENC group compared to NC group, while PC group was intermediate, indicating enzyme supplementation had a

positive effect on weight gain in pigs. The response of piglets to different enzymes, especially the carbohydrases reported in the literature tends to vary (Bedford and Schulze 1998) due to factors such as enzyme source, ingredient variety, age and health of animals and interactions of enzymes with dietary ingredients. Specific fibrolytic enzymes such as xylanase is reported to be beneficial in wheat and barley based diets due to high xylan content (Zijlstra 1999) but multi-enzyme cocktail was also beneficial for diets based on corn and soybean meal as reported (Zijlstra 2001) showing, fibre degrading enzymes resulted into improved utilization of fibre in high fibre and low energy diets.

Feed conversion ratio: Feed conversion ratio was significantly ($P < 0.01$) lower in ENC and PC groups compared to NC group. The enzyme supplementation to high fibre and low energy (ENC) diet has a valuable positive effect on the FCR compared to NC group, indicating better utilization of nutrients in enzyme supplemented group. In a similar study (Mavromichalis *et al.* 2000) with wheat based diets demonstrated that, xylanase supplementation tend to improve nutrient digestibility and reduced feed intake, while growth performance was similar. Another study (Kiarie *et al.* 2007) also suggested that, the supplemented exogenous carbohydrases and proteases improve the availability of energy from fibre of pig diets, thereby improving the feed efficiency and similar findings were also reported by Kim *et al.* (2001). The proteases may also contribute to neutralization of anti-nutritional factors present in soya based NC diet, besides increasing the digestibility of protein with overall effect on reduced FCR values fed with enzyme-supplemented (ENC) diet in piglets.

Economics: Cost of gain was also lower ($P < 0.01$) in ENC group followed by PC group than NC group of piglets. Cost of feeding was lower in piglets fed ENC diet (12.1%) followed by PC diet (10.3%) compared to NC diet, whereas cost of feeding recorded for ENC diet was 1.7% lower than PC diet (Table 3). This reduction in cost might be due to increased feed conversion efficiency and higher body weight gains achieved by piglets fed ENC diet, which explains the lower feeding cost when diet included cocktail of enzymes. Our results were in agreement with the findings of Kim (2002), who reported enzyme supplementation has improved gain/feed in growing piglets.

This experiment was conducted to study the effect of supplementation of cocktail of enzymes in high fibre and low energy diet in comparison to low fibre and high energy diets on growth performance and feed conversion ratio of Large White Yorkshire piglets. The present study demonstrated the potential for using cocktail of enzymes in improving the performance of growing piglets without causing any health problems and with significant reduction in cost of meat production. Thus, incorporation of enzymes in the high fibre and low energy diets of piglets appears to be beneficial for livestock producers.

SUMMARY

Large White Yorkshire piglets (18) were used to evaluate the effect of supplementing a cock tail of enzymes (cellulase, xylanase, protease, lipase, phytase, pectinase, hemicellulase, amylase, β -mannanase and β -glucanase) in pig diets on growth performance, feed conversion efficiency and economics. Piglets were fed basal diets and assigned randomly to one of 3 dietary treatments. Treatment diets were positive control diet with low fibre-4.48%; high energy-ME, 2800 Kcal/kg (PC; n, 6), negative control diet with high fibre-6.7%; low energy-ME, 2500 Kcal/kg (NC; n, 6) and negative control diet supplemented with enzymes (ENC; n, 6). Dry matter (DM) intake, was tended to be lower for the NC and ENC groups compared to PC group. The final weight, total gain and ADG were significantly higher on ENC group compared to NC group, while PC group was intermediate. The feed conversion ratio and cost of gain was significantly lower in ENC and PC groups compared to NC group of piglets. Cost of feeding was lower in piglets fed ENC diet (12.1%) followed by PC diet (10.3%) compared to NC diet, whereas cost of feeding recorded for ENC diet was 1.7% lower than PC diet. Therefore, the enzyme cost is marginal relative to the benefits achieved and is justified for inclusion in swine diets and any attempt to reduce the feed cost by the utilization of feed grade enzymes in diets would improve the profitability.

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