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The Effects of Enzyme Complex on Performance and Nutrient Digestibility of Weaned Pigs in North Eastern Region of Tripura

Tapan Kumar Das[1], Jowel Debnath[1], Sandip Chakraborty[2*] and Bikas Chandra Debnath[3]

[1]Department of Livestock Farm Complex, College of Veterinary Sciences & A.H., R.K. Nagar, Tripura, INDIA
[2]Department of Veterinary Microbiology, College of Veterinary Sciences & A.H., R.K. Nagar, Tripura, INDIA
[3]Department of Animal Nutrition, College of Veterinary Sciences & A.H., R.K. Nagar, Tripura, INDIA

**Corresponding author: S Chakraborty; E-mail: chakrabortysandip22@gmail.com*

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ABSTRACT

Present study demonstrates the effect of enzyme supplementation on performance of weaned pigs. 15 nos of 56 days old Large White Yorkshire piglets with mean body weight of 10.43 ± 0.20 kg were randomly assigned to 3 treatments (Control, T_1& T_2) with 5 piglets in each group and were fed with iso-nitrogenous and iso-caloric diets containing the enzyme complex product at 0, 5 and 6 kg/ton of feed, respectively for 28 days. The result showed that there was no significant differences (P>0.05) on body weight but enzyme supplementation increases the body weight@7.86% and 7.93% in T_1 and T_2 groups, respectively compared to control. T_2 group showed significant difference (P<0.05) in body length, chest girth and loin girth of pigs whereas no significant effect (P>0.05) was found on average height at wither. Average daily gain (g/day) in T_1 and T_2 groups was found to be increased (P>0.05) by 25.06% and 21.41%, respectively than the control group. Pigs fed diets supplemented with enzyme complex tended to have increased (P<0.05) digestibility of dry matter (DM) and crude protein (CP). In conclusion, 6 kg/ton of dietary enzyme complex can be supplemented in the diet of weaned pigs for better growth performance.

HIGHLIGHTS

- Digestibility of DM & CP increases by supplementation of enzyme complex.
- Better growth performance in weaned pigs is achievable with 6kg/ton of dietary enzyme complex supplementation.

Keywords: Digestibility, Enzyme, Growth, Height, Pig

Pig feed mostly composed of cereals and vegetable proteins which cannot be fully digested and utilized by animals. Many cereals and other feed ingredients contain non-starch polysaccharides (NSPs), commonly known as fibre. Non-ruminant animals are unable to produce endogenous enzymes to digest NSP and due to this, NSP can increase the viscosity of digesta, alter the intestinal epithelial morphology and reduce the digestibility of nutrients (Lindberg, 2014; Passos *et al.,* 2015). Thus, exogenous enzymes supplementation reduces the NSP content in the digesta and consequently, enhances the use of nutrients (Pedersen *et al.,* 2012; Lærke *et al.,* 2015). Addition of enzymes like cellulase, xylanase etc to pig diets improved digestion, increased availability of metabolizable energy and thereby improved performance of pigs (Lei *et al.,* 2005) by breaking down these NSPs and lowering viscosity in the intestine. Exogenous enzymes have been successfully used in the pigs to minimize the negative effect of NSPs, to stimulate nutrient digestibility and improve nutritive values of high NSP containing feedstuff (Willamil *et al.,* 2012; Kianfar *et al.,* 2013; Karimi & Zahedi 2015).

It is important to note that pigs are subjected to very

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high stress imposed upon by weaning and this is accompanied by remarkable changes in the physiology of the gastrointestinal tract (Falculan, 2021). However, it is reported that exogenous enzymes (b-glucanase, xylanase, protease etc) improved the digestibility of crude protein and energy (Yin *et al.,* 2004; Ji *et al.,* 2008), improved nutrient utilization and growth performance in weaned pigs (Omogbenigun *et al.,* 2004; Jo *et al.,* 2012). In most of the studies, pigs were fed corn/soyabean based diet. However little information is available regarding the effect of exogenous enzyme supplementation in wheat based pig ration in climatic condition of North Eastern region of India. Hence the present study on supplementation of exogenous enzymes to wheat based pig diets was conducted to assess its influence on their performance in climatic condition of Tripura.

MATERIALS AND METHODS

This study was conducted at the Satellite Nucleus Pig Unit of College of Veterinary Sciences & A.H., R.K. Nagar, West Tripura. Fifteen numbers of 56 days old Large White Yorkshire piglets with mean body weight of 10.43 ± 0.20 kg were randomly assigned to 3 treatments with 5 piglets in each group. The initial weight of the animals by treatment was homogenised as much as possible. All the piglets were kept 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.

Feeding was carried out at 07:00 and 13:00 h each day for 28 days. Control group was given basal diet without enzyme supplementation and T_1 and T_2 group was supplemented with Brozyme @ 0.50% and 0.60% respectively. Diets were formulated to meet the body requirements of growing pigs (BIS, 2001). These piglets were fed with standard concentrate ration having 17.53% crude protein and 3030 Kcal ME/kg during the experimental period. Brozyme (Zeus Biotech Private Limited) is a natural combination of 15 enzymes, composition of which is given in Table 1. Ingredient and chemical composition of the feed mixtures are given in Table 2. Drinking water was provided *ad libitum*. The pigs were housed in a naturally ventilated individual pen with floor size area of 2 m^2.

Table 1: Composition of Brozyme

Brozyme	*Amylase, Galactosidase, Cellulases, beta-Glucanse, Lipase, Pectinase, Proteinase, Xylanase, Phytase, Mannase, B. Subtilis, B. Licheniformis, B. Polymyxa, B. Megaterium, B. Sporogenes*

Table 2: Ingredient and chemical composition of concentrate mixture

Ingredient	**Concentrate**
Wheat	61
GNC	13
Deoiled rice bran	17
Fish meal	7
Vitamin and Mineral mixture*	1.5
Salt	0.50
Chemical composition (% on DM basis)	
OM	96.59
Crude protein	17.53
Ether extract	2.66
Crude fibre	5.13
Total ash	3.41
Lysine%	0.82
Methionine %	0.31
Methionine + Cysteine%	0.56
Ca%	1.13
Available Phosphorus%	0.34

*Vitamins and mineral premix per kilogram contained: Vitamin A 2,000,000IU, Vitamin D3 150,000IU, Vitamin K 0.33 mg, Vitamin B1 0.33 mg, vitamin B2 1.0 g, Vitamin B6 0.33 g, Vitamin B12 1.7 mg, Pantothenic acid 66.7 mg, Se 16.6 mg, Co 1.33 mg, Cu 0.5 g, I 16.6 mg and Antioxidant 10.0 mg

Initial body weight of weaner pigs were recorded using weighing scale with a 0.05 g precision and weekly records of change in body weight were subsequently documented. The linear body measurements data were also recorded at 0 and 28 days of experiment using a graduated ruler and tape.

One digestibility trial was conducted at the end of the trial for 5 days duration. All the piglets were kept in an individual pen and given exactly the same growing period diets. Total faeces were collected at 08.00 h of each day. The daily excreta of each piglet collected at each time

was weighted and 10% HCl was added at a ratio of 100 g of wet fecal sample to 10 ml 10% HCl and subsequently stored in a sealed plastic bag at 4°C. At the end of the 5-d period, all bags containing daily faeces of each piglet were mixed thoroughly. An equal amount of daily faecal sample from the same piglet was pooled and a single subsample (10% of the total weight) was then oven dried at 60°C to constant weight and ground to pass a 1.0-mm screen for analysis to calculate the total tract digestibility of crude protein (CP), ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE).Samples of feed and faeces were analyzed for dry matter (DM), crude protein (CP), crude fibre (CF) and ash according to standard AOAC (2007) methods. The data were analyzed using two way ANOVA (Sigma Plot software, version 11.0; SPSS Inc., Chicago IL). The results were expressed as mean and pooled standard error of mean.

RESULTS AND DISCUSSION

Effects of dietary multienzyme supplementation on body weight of weaned pigs represented in the Table 3. Initially, average body weight was similar among treatment groups but at the end of the experiment enzyme supplemented group (T_1 and T_2) showed comparatively higher (P>0.05) body weight than the control. It was found that enzyme supplementation increases the body weight @ 7.86% and 7.93% in T_1 and T_2 groups, respectively compared to control indicating enzyme supplementation had a positive effect on weight gain in piglets.

Table 3: Effects of dietary supplementation of multienzyme on body weight of weaned pigs

Days	Control	T_1	T_2	SEM
0	10.51	10.53	10.72	0.24
7	11.52	11.91	12.05	0.24
14	13.11	13.09	13.10	0.27
21	13.77	15.00	14.38	0.32
28	15.17	16.36	16.37	0.26

The finding are in agreement with the findings of Thacker *et al.* (1991); Bedford *et al.* (1992); Baas and Thacker (1996); Jensen *et al.* (1998); Mavromichalis *et al.* (2000); Thacker (2001); Reddy *et al.* (2011); McAlpine *et al.* (2012); O'Shea *et al.*(2014); Thacker (2015) but in contrast with Bedford *et al.* (1992); van Lunen and Schulze (1996); O'Doherty and Forde (1999) and Omogbenigun *et al.* (2004) who reported improved growth performance in pigs fed enzyme supplementation. The inconsistent results reported by several authors of animal responses to the exogenous multienzyme supplementation can be explained by the differences in diet composition and variations of exogenous multienzyme activities and age of animals used (Kim *et al.,* 2011). In the present experiment, comparatively lower positive effects of the exogenous multienzyme supplementation on growth performance of piglets may be due to the improved digestive capacity of weanling piglets such as the maturation of endogenous enzyme-secreting system and the increase in gastrointestinal microbial populations as they gets older (Omogbenigun *et al.,* 2004; Parra *et al.,* 2012).

Table 4: Effects of dietary supplementation of multienzyme on body measurement of weaned pigs

Parameters	Group		
	Control	T_1	T_2
Initial average length (cm)	54.00 ± 0.88	54.13 ±0.56	54.25 ±1.28
Initial average length (cm)	56.50^{a} ± 0.42	57.00^{ab} ± 0.89	59.23^{b} ± 0.72
Weekly body length gain (cm)	0.63 ± 0.12	0.72 ± 0.32	1.24 ± 0.18
Initial average chest girth (cm)	50.00 ± 0.16	50.75 ± 0.78	51.25 ± 0.73
Final chest girth gain (cm)	54.25^{a} ± 0.34	55.63^{ab} ± 0.70	56.50^{b} ± 0.91
Weekly chest girth gain (cm)	1.06± 0.05	1.22 ± 0.30	1.31 ± 0.06
Initial average loin girth (cm)	50.40 ± 0.66	52.55 ± 1.03	52.20 ± 0.86
Final average loin girth (cm)	52.63^{a} ± 0.83	54.80^{ab} ± 0.73	55.38^{b} ± 0.80
Weekly loin girth gain (cm)	0.56 ± 0.14	0.56 ± 0.09	0.79± 0.16
Initial average height at wither (cm)	32.88 ± 0.46	33.00 ± 0.65	32.88 ± 0.33
Final average height at wither (cm)	34.70 ±0.25	34.50 ± 0.50	35.58 ± 0.35
Weekly height at wither gain (cm)	0.46 ± 0.08	0.38 ± 0.09	0.53 ± 0.17
Average daily gain (gm)	16.65 ± 1.18	20.82 ± 1.75	20.21 ± 0.83

Mean within the rows bearing different superscript are significantly different (P<0.05)

Effects of dietary multienzyme supplementation on body measurements of weaned pigs have been represented in the Table 4. It was found that at the end of the experiment, compared to control, T_2 group showed significant difference (P<0.05) in body length, chest girth and loin girth of pigs whereas no significant effect (P>0.05) was found on average height at wither. By statistical analysis, it was found that there was no significant difference in body length, chest girth, loin girth and height at wither of pigs between T_1 and T_2. It has been found that compared to control, at higher dose of enzyme supplementation 4.83%, 4.15%, 5.23% and 2.54% more increased in body length, chest girth, loin girth and height at wither, respectively were observed. Similarly, weekly gain (cm) in body length, chest girth, loin girth and height at wither was 99%, 23.53%, 42.68% and 17.07% more increased in T_2 groups than control. In this experiment, pigs fed with 6 kg/ton enzyme complex had comparatively higher body weight might be attributed for the higher body measurements. This is in close agreement with the findings of Singh and Dhir (1986) and Njoku *et al.* (2013) who reported high correlation values in linear body measurements and body weight in intact and castrated pigs. But till date no evaluation of effect of enzyme supplementation on body measurements in pig had been reported.

Dietary treatments also did not showed any effect (P>0.05) on average daily gain but in T_1 and T_2 groups, average daily gain was increased @ 25.06% and 21.41%, respectively than the control group. This is in close agreement with the findings of Quiniou *et al.* (2010) who reported no significant differences in daily weight gain and final weight between castrated and intact boars. In contrast to present findings, enzyme supplementation in the diets had increased the weight gain by 5-9% in weaned pigs (Reddy *et al.,* 2011; Omogbenigun *et al.,* 2004; Lei *et al.,* 2005; Bharathidhasan *et al.,* 2010; Liu *et al.,* 2010) and in finishing pigs (Frankiewicz *et al.,* 2003; Teixeira *et al.,* 2005). The stress of weaning usually caused disordered digestive enzymes secretion (Hartma *et al.,* 1961; Lindemann *et al.,* 1986) and low antibody concentration (Levast *et al.,* 2010). Therefore, it is necessary to supply digestive enzymes for weaned pigs. The improvements in average daily gain due to enzyme supplementation reported by several authors arose mainly due to positive response to phytase component of enzyme complex. In this study, dietary treatments also did not showed any effect (P>0.05) on average daily gain that may be due to short duration study.

Table 5: Effects of dietary supplementation of multienzyme preparation on nutrient digestibility of weaned pigs

Parameters	C	T_1	T_2	SEM
DM dig	82.60^{a}	83.50^{ab}	84.43^{b}	0.32
CP dig	79.75^{a}	81.03^{ab}	83.00^{b}	0.57
EE dig	79.79	82.60	81.64	1.21
CF dig	55.44	56.67	58.80	2.04
NFE dig	92.79	91.71	92.15	1.34

^{ab}Means bearing different superscript in the row differ significantly (P<0.05).

Effects of dietary multienzyme supplementation on nutrient digestibility of weaned pigs represented in the Table 5. Pigs fed diets supplemented with higher dose of enzyme complex tended to have increased (P<0.05) digestibility of DM and CP but no effect was found in lower dose. However, the digestibility of EE, CF and NFE was not affected (p>0.05) by enzyme supplementation. Enzyme supplementation in T_2 group improved the digestibility of DM and CP by 2.2 and 4%, respectively. In the present study, comparatively improved growth performance in enzyme supplemented groups may be partially attributed to increased DM digestibility. This result is consistent with previous findings (Café *et al.,* 2002; Omogbenigun *et al.,* 2004; Olukosi *et al.,* 2007; Xu *et al.,* 2011; Yi *et al.,* 2013; Kim *et al.,* 2018). Generally, the anti-nutritive factors like non starch polysaccharides (NSP) in feed are known to interfere with the digestibility of other macronutrients, thereby reducing feeding values (Bell *et al.,* 1983). Therefore, NSP enzymes are generally combined with digestive enzymes. In the research of Li *et al.* (2010) enzyme blends (amylase, protease and xylanse) addition resulted in increased (P<0.05) DM and CP digestibility of non-extruded corn diets which was similar to our present findings. In our study, enzyme complex may have exerted its beneficial effects first through breaking down the plant cell wall structure and thereby releasing the nutrients contained in the cell wall for use by the pig (Bedford and Schulze, 1998). In contrast to present findings, Willamil *et al.* (2012) indicated that there was no effect on digestibility of DM, CP, and energy in growing pigs fed wheat–barley–rye–SBM-based diets supplemented with a multienzyme.

CONCLUSION

It can be concluded from the present study that 6kg/ton of dietary enzyme complex can be supplemented in the diet of weaned pigs for better growth performance.

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