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Effects of Dietary Supplementation of Enzymes in a Soybean Meal Rich Diet on the Performance of Weaned Pigs (4 – 8 weeks)

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ABSTRACT

The effects of non starch polysaccharides degrading enzymes (NSPase) type mixture supplementation in high soybean meal weaned pigs diet were studied by using 96 crossbred (LR ¥ LW ¥ D) pigs aged 4 weeks. The animals were divided into 12 groups of 8 animals each. Animals in each group were kept in a battery metal cage where feed and water were provided *ad libitum*. Each group of the animals was randomly fed one of the experimental diets as until 8 weeks of age. The diets were as follow: Diet 1: A control broken rice-soybean meal (18%)-fish meal (8%)-skimmed milk (3%) diet; Diet 2: A negative control broken rice-soybean meal (23%)-fish meal (1%)-skimmed milk (2%) diet; and Diet 3: Diet 2 but supplemented with NSPase type mixture (AVEzyme02) at dosage of 500 g/ton feed. Animals on Diet 2 had significantly poorer ($P<0.05$) average weight gain, average daily gain, average feed intake, average daily feed intake, feed conversion ratio (FCR) and higher mortality rate than those on Diet 1. The enzyme supplementation of the high soybean meal diet (Diet 3) significantly improved ($P<0.05$) performances of the weaned pigs, which were very comparable to those on the control high fish meal and skimmed milk diet (Diet 1). The different, however, were not statistically significant. The NSPase type mixture is safe, cost effective and demonstrated a potential of beneficial effects on improvement of soybean meal utilization in weaned pig diet.

Key words: weaned pigs, enzymes in a soybean meal rich diet, NSPase

INTRODUCTION

The use of enzymes in feeding of weaned pigs has been well documented in recent years (Partridge, 2001). For the enhancement of the nutritional value of soybean meal in piglets, mainly three types of enzyme preparations have been used. These are the oligosaccharide degrading enzymes, the protease type enzymes and finally the NSP (Non Starch Polysaccharide) degrading enzyme mixtures. Recent evidence showed that pectic – NSP could reduce the uptake of amino acids like lysine and threonine when added to piglet feeds (Zhu and Lange, 2001). The cell walls of soybeans consist mainly of two intertwound NSP ultrastructures, composed of neutral glucan-xylan type primary cell walls and secondly of ionic pectic cell wall components (Huisman *et al*., 2000). The entrapment of amino acids by fibers seem to be an important factor in the digestibility of amino acids (Jondreville *et al*., 2000), and negative influences on the endogenous excretion of amino

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acids (proteins). The enzyme mixture used in this test consisted of the NSPase type of mixture, with enzyme activities towards the neutral glucan-xylan type and ionic pectic type of cell wall components. The purpose of this study was to measure the effects on the performance and health of active enzyme preparation (AVEzyme 02) on a soybean meal rich diet for weaned pigs from 4 to 8 weeks and to measure the effects on the economic performances of the animals.

MATERIALS AND METHODS

The experiment was conducted at a commercial pig farm in Kampaengsaen district, Nakhon Pathom province, Thailand and utilizing the completely randomized design (CRD). A total of 96 crossbred (LR ¥ LW ¥ D) weaned pigs aged 4 weeks were divided into 3 groups of 32 animals each. Each group of the animal was further divided into 3 sub-groups of 8 animals each and containing an equal number of males and females. Each sub-group of the animals was kept in a 1.5 ¥ 2.0 meters metal battery cage where feed and water were provided *ad libitum*.

Each group of animals was randomly fed one of the experimental diets until 8 weeks of age as follow:

Diet 1: A positive control diet containing broken rice-soybean meal (13.52%) and high level of fish meal (8%), skimmed milk powder (3%) and sugar (2%).

Diet 2: A negative control diet containing broken rice- high level of soybean meal (23.6%) and low level of fishmeal (1%) and skimmed milk powder (2%) and no sugar.

Diet 3: Diet 2 but supplemented with NSPase (AVEzyme02) at 500g/ton feed

The AVEzyme02 is an NSPase type mixture containing glucanase, xylanase and pectinase, and specially designed for high soybean meal weaned pigs ration, manufactured by AVEVE, B.V., Belgium. All experimental diets were formulated according the nutritional recommendations in Thailand (Kanto, 1994). Feed ingredients and chemical composition of the diets are shown in Table 1. The diets were fed in mashed form to the animals.

Initial weight, final weight, feed intake and incidence of diarrhea of the experimental animals were recorded throughout the experiment. The data were subjected to analysis of variance and the differences among means were tested with Duncan's New Multiple Range Test (SAS, 1998).

RESULTS AND DISCUSSION

The performances of weaned pigs fed the experimental diets from 4 to 8 weeks of age are shown in Table 2. The results are indicating that animals on the negative control diet (Diet 2) had significantly ($p<0.05$) poorer average weight gain, average daily gain, and feed conversion ratio than those on the positive control diet (Diet 1). Pigs on negative control diet (Diet 2) not only had high incidences of diarrhea as compared to the other treatments but also had a significantly ($p<0.05$) higher mortality rate than those on the positive control diet (Diet 1). Soybean meal used in the study was solvent extracted but not dehulled and contained an acceptable level of urease activity. Soybean meal can contain allergenic substances that are harmful to the microvilli of the intestinal tract and impair nutrient digestion and absorption especially in the young animal as well as weaned piglets (Pedersen, 1988). NSP structures and components can negatively influence the digestion (Zhu and Lange, 2001 and Huisman *et al*., 2000). Higher levels of soybean meal in the weaned pig diet cause poor nutrient digestion and absorption, higher incidence of diarrhea, poor performances of the animals and higher mortality rate (Pedersen, 1988). It is therefore a normal practice in Thailand that weaned pig diets should contain more digestible protein i.e. fishmeal and should contain not more than 15 % soybean meal in the diet.

Table 1 Feed ingredients and chemical composition of the experimental diets.

Feed ingredients	Diet 1	Diet 2	Diet 3
Broken rice	56.93	52.90	52.90
Soybeanmeal	13.52	23.62	23.62
Extruded FFSB	15.00	15.00	15.00
Fishmeal (64%)	8.00	1.00	1.00
Skimmed milk powder	3.00	2.00	2.00
Sugar	2.00	-	-
Dicalcium phosphate	2.40	3.50	3.50
Salt	0.35	0.35	0.35
Fish oil	1.00	1.00	1.00
L-Lysine HCI	0.15	0.20	0.20
DL-Methionine	0.15	0.18	0.18
Premixes	0.50	0.50	0.50
AVEzyme02 (g/ton)	-	-	500
	100	100	100
Chemical composition by calculation			
Crude protein (%)	22.00	22.00	22.00
ME (kcal/kg)	3333	3378	3378
Fat (%)	5.08	4.41	4.41
Fiber (%)	2.34	2.94	2.94
Calcium (%)	1.05	1.05	1.05
Avail.Phos. (%)	0.80	0.80	0.80
Lysine (%)	1.41	1.40	1.40
Met+Cys (%)	0.85	0.85	0.85
Tryptophan (%)	0.27	0.29	0.29
Threonine (%)	0.91	0.91	0.91
Cost (Baht/kg)	10.75	9.72	9.81

Prices of May, 2001

However, the results of the study have shown that improvement of soybean meal digestibility by dietary enzyme supplementation have considerably improved the utilization of soybean meal in the weaned pig diets. Animals on negative control diet (high soybean meal/low fish meal) but supplemented with AVEzyme02 at 500 g/ton feed (Diet 3) had very comparable performances in terms of average weight gain, average daily gain, feed conversion ratio and mortality rate as compared to those on the positive control diet (Diet 1) and the differences were not statistically significant. Yet, animals on the enzyme supplemented diet (Diet 3) had a significantly ($p<0.05$) higher feed intake than those on the positive control diet (Diet 1). In addition, pigs on the enzyme supplemented diet (Diet 3) had lower incidences of diarrhea than those on the negative control diet (Diet 2) but not different from those on the positive control diet. The results of the study demonstrated that dietary AVEzyme02 supplementation not only improved performances

Table 2 Performances of weaned pigs fed experimental diets from 4 to 8 weeks of age.

	Diet 1	Diet 2	Diet 3
No. of animals	32	32	32
Av. initial wt. (kg/animal)	8.07±0.667	7.98±0.385	7.77±1.059
Av. final wt (kg/animal)	17.72^{ab}± 2.14	17.10^{b}±0.62	18.28a±2.02
Av. weight gain (kg/animal)	$9.43±1.697^{a}$	$9.12±0.648^{b}$	$9.61±1.67^{a}$
Av. daily gain (kg/animal)	$0.32±0.065^{a}$	$0.28±0.022^{b}$	$0.35±0.037^{a}$
Av. feed intake (kg/animal)	$0.46±0.037^{b}$	$0.44±0.026^{b}$	$0.50±0.064^{a}$
Feed conversion ratio	$1.44±0.104^{b}$	$1.62±0.072^{a}$	$1.44±0.089^{b}$
Av. feed cost/kg gain (bath/kg)	15.43^{a}	15.70^{a}	14.11^{b}
Incidence of diarrhea (%)	34.38	43.65	34.38
Mortality rate (%)	4.93^{b}	14.04^{a}	4.66^{b}

a,b Means in the same line with different superscripts are significantly different (P<0.05).
Diet 1: A control broken rice-soybean meal (18%)-fish meal (8%)-skimmed milk (3%)-sugar (2%) diet.
Diet 2: A negative control broken rice-soybean meal (23%)-fish meal (1%)-skimmed milk (2%)-no sugar diet.
Diet 3: Diet 2 but supplemented with NSPase type mixture (AVEzyme02) at 500 g/ton feed.

but also reduced incidence of diarrhea and mortality of the weaned pigs on high soybean meal diets. Although the study did not test the direct soybean meal digestibility with AVEzyme02 supplementation, the results indicated that the enzymes would increase the efficiency of soybean meal and might reduce allergenic effects or negative effects of soybean meal on the absorption of the nutrient in the animals. It is very interesting to evaluate the effects of AVEzyme02 supplementation on the improvement of soybean digestibility either in vitro or in vivo and the enzyme effect on the condition of microvilli in weaned pigs fed high soybean meal diets.

Performances of animals, especially average daily gain and average daily feed intake were slightly poorer than the industrial standard which is probable due to experimental diets and environmental factors. The experimental diets were supplemented with minimal levels of antibiotics in order to show the maximal effect of dietary enzyme supplementation on health and mortality rate of the animals. The starch in the diets was uncooked and might have caused a certain degree of diarrhea in every treatment group. In addition, the experimental period (May – July) was in the very hot and humid months due to the changing of the hot summer to the rainy season which may also have caused stress to the animals and resulted in a certain degree of diarrhea in every treatment group. Together with high level of soybean meal in the diet, these stress conditions contributed to poor performances, high incidence of diarrhea and high mortality rate of the animals on the negative control diet (Diet 2). However, dietary AVEzyme02 supplementation of 500 g/ton (Diet 3) was shown to reduce incidence of diarrhea and mortality rate of the animal to normal.

The feed cost of Diet 1, 2 and 3 were 10.75, 9.72 and 9.81 Bahts/kg (Table 1) and the relative feed cost to the control were 100, 90.42 and 91.26 %, respectively. Reduction of the feed cost of Diet 2 resulted in significantly poorer (P<0.05) feed conversion ratio and higher (P<0.05) mortality rate of the animals and significantly increased (P<0.05) the feed cost/ body weight gain when compared to those on the control diet. The enzyme supplementation of Diet 2 (Diet 3) on the other

hands, resulted in the significant improvement ($P<0.05$) of the feed conversion ratio and mortality rate of the animals comparable to the control. Results of the study indicated that the enzyme supplementation in high soybean meal, low fishmeal, low skimmed milk and no sugar weaned pig diet (Diet 3) were not only significantly associated with a reduced ($P<0.05$) the feed cost/ body weight gain of the animals but also provided the animals health (incidence of diarrhea and mortality rate) comparable to those on the control diet (Diet 1).

CONCLUSION

The use of high levels of soybean meal (23.62%) and extruded full-fat soybeans (15%) in diets for weaned pigs (4 to 8 weeks of age) caused poor performances, higher incidences of diarrhea, and higher mortality rates than diets containing a lower level of soybean meal (13.52%), higher levels of fishmeal (8%), higher levels of skimmed milk (3%) and 2% of sugar. The NSPase (AVEzyme02) supplementation in a high soybean meal weaned pig diet not only significantly ($p<0.05$) improved performances but also significantly ($p<0.05$) reduced incidences of diarrhea and mortality of the animal. Animals on the enzyme supplemented high soybean meal diet had no significantly different performances, incidence of diarrhea and mortality as compared to those on the low soybean meal, high fish meal diet. AVEzyme02, an enzyme blend of the NSPase type can improve the utilization of soybean meal and allow a reduced use of fishmeal, skimmed milk power and sugar in weaned pig (4 to 8 weeks) diets.

The experiment showed that rations for weaned pigs, consisting of protein sources with high bio-nutritional value such as fishmeal, could successfully and efficiently be replaced to a considerable extent by soybean meal supplemented with an adequate the NSPase mixed enzymes.

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