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ANIMAL

Effect of the Yea-Sacc yeast culture on growth performance, nutrient digestibility and fecal score in weanling pigs

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Abstract

The influence of dietary supplementation with a yeast culture on growth performance, fecal score and nutrient digestibility was evaluated in weaned pigs in a 6-week feeding trial. A total of 50 weaning pigs with an initial average body weight (BW) of 7.46 ± 1.60 kg were randomly allotted into 1 of 2 dietary treatments according to the initial BW. There were 5 replicate pens in each treatment with 5 pigs per pen. The dietary treatments were as follows: 1) control, basal diet (CON) and 2) 0.10% yeast culture, basal diet supplemented with 0.1% yeast culture (YC). The average daily feed intake was significantly improved with the dietary supplementation of the yeast culture compared with the control during phases 1 and 3. Overall (0 to 6 weeks), dietary supplementation with the 0.1% yeast culture had a significant effect on the feed conversion ratio (FCR). There was no significant difference in the fecal score between the CON and YC dietary treatments. In addition, no difference in the apparent total tract digestibility was observed between the CON and YC dietary treatments. Collectively, the results of this study indicate that dietary supplementation of 0.1% yeast only improved the feed intake of weaning pigs; however, yeast culture supplementation did not affect the average daily gain, feed efficiency, total tract digestibility of dry matter, and nitrogen and energy levels as well as the fecal scores.

Keywords: fecal score, growth performance, nutrient digestibility, weaning pigs, yeast culture

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Introduction

Weaning pigs face multiple challenges during the transition phase of their lives. These challenges include the stress of separation from sows and littermate, a different food source, co-mingling with unrelated litters, alteration in housing environment, transportation stress etc. (Campbell et al., 2013). As a result of these stress related changes, the piglets are deprived of growth, have reduced feed efficiency (Jensen et al., 1997), reduced immune functions, changes in intestinal integrity and incidence of diarrhea. It has been reported that about 11% of mortality rate in post weaning piglets is due to the incidence of diarrhea (Owusu-Asiedu et al., 2003). Thus, post weaning diarrhea is the one

of the major cause of economic loss in pig industry.

To alleviate the post-weaning diarrhea, nutritional regulation may play an important role. Several feed additives such as nutraceuticals, acidifier, pre/probiotics, yeast culture, minerals, and phytogenic are added to weaning pigs' diet as an alternative antimicrobial growth promoter (Vondruskova et al., 2010; Debski, 2016).

The use of yeast as a source of protein, vitamins, and minerals in animal feeds has a long history (Anupama and Ravindra, 2000; Bekatorou et al., 2006). The protein found in yeast cell has been reported by several researchers to be very effective in accelerating growth and improving the health of ruminant animal by stimulating rumen acetogens (Halász and Lásztity, 1991; Klein and Favreau, 1995; Kurtzman et al., 2011a, b). In addition, the use of yeast cell wall polysaccharides as feed additive has been found to improve the health of growing pigs (Sauerwein et al., 2007). The inclusion of yeast culture in the diet has been demonstrated to improve the gastro intestinal tract's morphological structure and promote the digestive system function of piglets (Giang et al., 2010).

Materials and methods

Experiment design, animals, diets and facilities

A total of 50 weaned pigs, initial body weight (BW) 7.46 ± 1.60 kg, they were randomly allotted to 2 treatments according to initial BW. There were 5 replicate pens in each treatment with 5 pigs per pen. They were fed 6 weeks. The dietary treatments included: 1) control, basal diet (CON); 2) 0.10% yeast culture, basal diet supplemented with 0.1% yeast culture (YC) (Yeast culture concentration [0.10%] is based on the recommended amount of company's experimental protocal). In the present study, we used dried yeast culture (Yea-Sacc®, Alltech, Lexington, USA). All experimental diets were formulated to meet or exceed the nutrient requirements recommended by the NRC (2012) (Table 1).

All of the weaning pigs were housed in an environmentally controlled nursery facility with slatted plastic floor and a mechanical ventilation system. The environmental temperature was maintained at 30℃ for the first week of the experiment. The environmental temperature was reduced by 1℃ per week over the next three weeks. The relative humidity was 60 - 65%, and these weaning pigs were provided light for 16 h daily throughout the experiment. There was a stainless steel feeder and one nipple water in each pen for weaning pigs. They were free to eat and drink water throughout the experiment.

Experimental sample preparation and measurements

The weaning pigs were weighed individually initially, at 2 weeks, 4 weeks and 6 weeks of the experiment. Weaning pigs' feed intake was recorded at the end of each phase on a pen basis to calculate the average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR). To evaluate the apparent total tract digestibility of dry matter (DM), nitrogen (N), gross energy (GE) was determined using 2 g/kg of chromic oxide added in the diets as an indigestible marker during the last seven days of each phase. All weaning pigs were fed diets with chromic oxide from d 36 to 42. Fecal samples were randomly collected from three pigs of each pen in the last three days of each phase. Fecal samples were pooled and dried in an air forced drying oven at 60℃ for 72 h. All feed and fecal samples were analyzed for DM, N and energy following the procedures outlined by the AOAC (2000) and then the apparent total tract digestibility were calculated.

At 08:00 and 20:00 hours, fecal score was evaluated and recorded initially, on weeks 2, 3, 4, 5, and 6. The fecal score was

determined as the average value of five pigs of each pen using a 5-grade score system (Hu et al., 2012), with grade of 1 standing for hard, dry pellets in a small, hard mass, grade of 2 for hard formed stool that remains firm and soft, grade of 3 for soft formed and moist stool that retains its shape, grade of 4 for soft unformed stool that assumes the shape of the container, and grade of 5 for watery liquid stool that can be poured. Scores were recorded on a pen basis following the observations of individual pig and signs of stool consistency in the pen.

Table 1. Composition of the experimental diets (as-fed-basis).

Items	0 - 2 Weeks	2 - 4 Weeks	4 - 6 Weeks
Ingredient (%)			
Corn	34.24	49.38	35.91
Barley	5.00	2.50	-
Wheat Flour	-	-	8.00
Soybean meal, 47% CP	4.70	16.50	24.90
Full fat soybean	3.50	5.00	6.00
Wheat-bran	-	-	3.00
Biscuit meal	-	-	8.00
Sugar	5.50	5.00	3.00
Soy hull	2.50	-	3.00
Soybean Oil	3.00	3.35	3.83
Fish meal	4.50	3.00	-
Spray-dried porcine plasma	4.00	2.50	-
Cheese powder	3.50	-	-
whey	20.50	6.00	-
Lactose	2.50	-	-
Whey permeate	-	-	2.50
Modified milk powder	5.00	5.00	-
Lys 78%	0.39	0.38	0.37
Met 99%	0.22	0.32	0.19
Tre 98%	0.17	0.14	0.15
Trp 10%	0.16	0.21	-
Limestone	-	-	0.70
Monocalcium phosphate 18%	-	0.17	-
Vitamin premi[y]	0.30	0.25	0.20
Mineral premi[z]	0.20	0.20	0.15
Choline 50%	0.12	0.10	0.10
Chemical composition (%)			
Digestive energy (kcal/kg)	3,968	3,913	3,562
Crude protein	20.34	19.18	18.44
Crude fiber	1.40	2.23	3.77
Crude ash	6.34	4.77	4.93
Calcium	1.00	0.72	0.91
Phosphorus	0.75	0.55	0.56
Lysine	1.67	1.50	1.31
Lactose	19.37	5.90	1.95

[y] The vitamin and mineral premix supplied per 1 kg of the diet: 20,000 IU of vitamin A, 3,000 IU of vitamin D_3, 80 IU of vitamin E, 12 mg of vitamin K, 150 mg of vitamin C, 20 mg of riboflavin, 60 μg vitamin B_{12}, 50 mg of D-pantothenic acid, 60 mg of biotin, 80 mg of niacin, 2 mg of vitamin B_6.
[z] 25 mg of Cu from $CuSO_4 \cdot 5H_2O$, 250 mg Fe from $FeSO_4 \cdot 7H_2O$, 70 mg of Mn from MnO_2, 58 mg of Zn from $ZnSO_4$, 0.2 mg of Se from $Na_2SeO_3 \cdot 5H_2O$, 0.3 mg of Co from $CoSO_4 \cdot 7H_2O$.

Statistical analysis

All data obtained in the current study were analyzed by ANOVA using the GLM procedure of SAS (SAS Institute, 1996). Duncan's multiple range test was used to compare the means of the treatments. Variability in the data is expressed as the standard error (SE) and probability level of $p < 0.05$ was considered to be statistically significant.

Results

Growth performance

No piglets were found dead because of disease or other reasons throughout the experiment. During 0 to 2 weeks and 4 to 6 weeks, dietary supplementation of 0.1% yeast had significant effect on average daily feed intake compared with control. During the overall experiment trail, there was significant effect on gain to feed ratio in pigs receiving diet supplemented with 0.1% yeast culture compared with control (Table 2).

Table 2. Effect of yeast culture on growth performance in weaning pigs.

Items	CON	YC	SE	p-value
Body weight (kg)				
Initial	7.42	7.45	0.01	0.615
WK2	11.64	11.89	0.13	0.376
WK4	18.63	18.66	0.32	0.475
WK6	26.12	26.44	0.42	0.813
Weeks 0 to 2				
ADG (g)	301	317	9	0.301
ADFI (g)	391b	425a	6.66	0.023
FCR	0.770	0.750	0.025	0.593
Weeks 2 to 4				
ADG (g)	499	483	20	0.129
ADFI (g)	755	755	24	0.994
FCR	0.661	0.640	0.026	0.071
Weeks 4 to 6				
ADG (g)	535	556	27	0.760
ADFI (g)	901b	937a	8.32	0.033
FCR	0.594	0.59	0.033	0.232
Overall				
ADG (g)	445	452	10	0.864
ADFI (g)	682	706	16	0.105
FCR	0.652a	0.64b	0.006	0.029

Each treatment had 5 replicates.
CON, Basal diet; YC, CON + 0.10% yeast culture; SE, Standard error of the mean; WK, week; ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio.
a, b: Means in a row with different letters are significantly different ($p < 0.05$).

Fecal score

The effect of yeast culture on fecal score is shown in Table 3. The supplementation of 0.1% YC in the diet of weaning pig had no significant effect on fecal scores compared with control.

Apparent nutrient digestibility

Supplementation of diet with 0.1% yeast culture did not have significant effects on the total tract digestibility of dry matter, energy and nitrogen compared with control (Table 4).

Table 3. Effects of yeast culture on fecal score in weaning pigs.

Focal score	CON	YC	SE	p-value
Initial	3.19	3.41	0.14	0.506
Week 2	3.28	3.20	0.07	0.387
Week 3	3.25	3.23	0.07	0.811
Week 4	3.18	3.16	0.06	0.489
Week 5	3.35	3.30	0.07	0.531
Week 6	3.38	3.36	0.07	0.411

Each treatment had 5 replicates.
CON, Basal diet; YC, CON + 0.10% yeast culture; SE, Standard error of the mean.

Table 4. Effect of yeast culture on nutrient digestibility in weaning pigs.

Items (%)	CON	YC	SE	p-value
Dry matter	80.39	81.10	0.31	0.583
Nitrogen	79.76	80.73	0.32	0.265
Energy	79.88	80.47	0.38	0.501

Each treatment had 5 replicates.
CON, Basal diet; YC, CON + 0.10% yeast culture; SE, Standard error of the mean.

Discussion

Growth performance

Yeast culture is rich in digestible non-animal protein. It is a good source of protein for animals, especially young animals. In addition, this yeast culture contains vitamins, fats, sugar, enzymes, nucleotides and some good growth factor for animals (Kornegay et al., 1995; Rutz et al., 2006) and it can aid in the secretion of variety of metabolites to the gastro-intestinal tract. So supplemented yeast culture in to diets not only provides nutrients to animals, but also contribute to growth of animals (Trckova et al., 2014). The nuclieic acid and glutamic acid present in the yeast culture contribute to improve the palatability of diets (Mutsvangwa et al., 1992) which might explain the reason of increased feed intake of piglets in the current study. However, other growth performance parameters such as ADG and FCR were not affected by 0.1% yeast culture supplementation during all three phases in the current study except for the increase in feed efficiency during the overall period of experiment. Canibe et al. (2007) reported that yeast culture could improve average daily gain (ADG) of weaning

pigs. Shen et al. (2009) also reported yeast culture contribute to improving the growth performance of piglets. Other authors also reported that yeast culture enhance growth performance (Gomes et al., 2006; Jiang et al., 2015) and promote gastrointestinal tract development of weaning pigs (Zauk et al., 2006). Some other studies suggested that yeast culture supplementation had not effect on growth performance of piglets (Rigueira et al., 2013). Likewise, no effect on growth performance with the supplementation of yeast cell wall components in broiler chicks was also observed (Morales-López et al., 2009). The variable response to yeast culture could be due to dose of yeast culture, types of yeast strain used for preparing the extract, procedure for yeast culture preparation, animal physiological status and farm conditions.

Fecal score

Fecal score is an intuitive and easy way to judge the piglets diarrhea. The piglets diarrhea has a direct effect on livestock production, because piglets diarrhea can cause some negative problems. And then it will reduce the profit of the production proceed. The main intestinal floras in tract of piglets are gram-positive bacteria lactic acid bacteria and gram-negative bacteria *E. coli*. Lactic acid bacteria is the main beneficial bacteria in the tract. It is able to product the lactic acid. These lactic acids in the tract can regulate the tract pH, and it is beneficial to growth of beneficial bacteria. *E. coli* is a harmful bacteria in the tract, which often cause diarrhea and all kinds of inflammation in young animals. The increase in the number of *E. coli* population will lead to digestive system disorders of piglets, which led to the diarrhea of piglets (Mathew et al., 1998). The yeast culture contain some polysaccharides that can inhibit the reproduction of harmful bacteria, and the same time yeast culture contain some other nutrients that can provide a powerful impetus for the growth of beneficial bacteria. Therefore, the yeast culture can improve the environment of tract and have a better control effect of piglets diarrhea (Castro et al., 2007). The yeast culture can significantly reduce the number of *E. coli* and increase the number of lactic acid bacteria in the tract of piglets, which can reduce diarrhea of piglets (Upadrasta et al., 2013). This study used fecal score to estimate the diarrhea of piglets. The supplementation of yeast culture had no significant effect on fecal score. In contrast, Trckova et al. (2014) reported that piglets fed yeast could significantly lower fecal score and reduced the number of *E. coli*. Van Heugten et al. (2003) also reported that supplementation with yeast culture could decrease the total bacteria. Because a lot of yeast would occupy an important position in the tract. The possible reason for no effect of yeast culture on fecal score could be feed time, feeding environment or the supplementation dose of yeast culture that had no beneficial effect on the structure of piglets intestinal floras.

Nutrient digestibility

It is important to measure the nutritional value and feed formulation design. The apparent total tract digestibility not only directly reflects the utilization of nutrients, but also indirectly judges the growth performance of weaning pigs. Pinloche et al. (2012) reported that supplementation of yeast culture in the diet can stimulate fermentation in the tract of weaning pigs, and it can increase content of volatile fatty acids and bacterial fermentation products. Therefore, supplemented yeast culture in the diet can contribute to improve the utilization of feeds. Van Heugten et al. (2003) reported that yeast culture supplementation had a positive effect on piglets digestibility. It can improve the digestibility of CP, DE and fat in the piglets. In the present study, the dietary supplementation with 0.1% yeast culture did not have significant effect on digestibility with agreed with the report of Li et al. (2006). The reason may be the lack of viable yeast cells in the yeast culture.

Conclusion

Dietary supplemented with 0.1% yeast culture had a significant effect on average feed intake of weaning pigs but no effects were observed on ADG, G : F, total tract nutrient digestibility as well as fecal scores. Thus, more studies are needed with higher dose of yeast culture to assess their effect as a functional product in weaning pigs.

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