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ANIMAL

Effect of brewer's yeast (*Saccharmyces cerevisiae*) supplementation on growth performance, nutrient digestibility, and fecal score of growing pigs

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Abstract

A total of 60 growing pigs (25.50 ± 1.63 kg) were used in a 6-week trial to investigate the effects of diet supplementation with brewer's yeast (*Saccharmyces cerevisiae*) on growth performance, nutrient digestibility, and fecal score of growing pigs. Pigs were randomly allocated to one of two dietary treatments [six replications (five pigs·pen^{-1})] according to initial body weight. The dietary treatments included: 1) control, basal diet (CON); 2) basal diet supplemented with 1% brewer's yeast. Dietary supplementation with brewer's yeast showed significant improvement in body weight (BW) at weeks 4 and 6; the average daily gain (ADG) and gain : feed ratio (G/F) was higher during week 4 and overall compared with CON ($p < 0.05$). Brewer's yeast supplementation in the diet had no significant on the nutrient digestibility. There was no significant difference in the fecal score of CON and brewer's yeast supplementation in the diet. In conclusion, the results indicate that dietary supplementation with brewer's yeast can improve growth performance in growing pigs. The results showed that supplementation of brewer's yeast in the diet of growing pigs had a positive effect on the ADG in growing pigs, but no significant effect on nutrient digestibility and fecal score when supplemented with brewer's yeast in the diet of growing pigs.

Keywords: brewer's yeast, fecal score, growth performance, growing pigs, nutrient digestibility

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Introduction

Yeast as the beneficial fungi genera has been widely used in animal husbandry production. And yeast is one of the most commonly supplemented in the dietary for improving nutritional strategies (Jiang et al., 2015). Live yeast dietary supplementation in weaning piglets enhanced intestinal morphology and growth performance (Bontempo et al., 2006). *Saccharomyces cerevisiae* is the predominant species used in food, beverage (distilled spirits and beer), and fuel ethanol production processes, where selected strains convert glucose and sucrose to ethanol (Reed and Nagodawithana, 1991). *Saccharomyces cerevisiae* is a non-pathogenic yeast. Yeast based products consist of products of fermentation, residual yeast cells, yeast cell wall fragments, and the culture used during fermentation (Shen et al., 2011). The report on Sauerwein et al. (2007) suggested that yeast cell wall supplemented in the diet of weaning piglets and fattened pigs diet, improved acquired immunity and growth performance. Yeast cultures supplemented in pigs, enhance gut immune response and nutrient digestibility (Shen et al., 2009). The pigs' gastrointestinal microbiota is primarily composed of not only Gram-positive bacteria, such as aerotolerant *Streptococcus*, microaerobe or obligate anaerobe *Lactobacillus*, *Bifidobacterium*, obligate anaerobe *Peptostreptococcus*, *Clostridium*, but also obligate anaerobe Gram-negative bacteria such as *Fusobacterium*, *Bacteroides*, *Selenomonas*, *Butyrivibrio*, *Prevotella* and *Salmonella*, facultative anaerobe *Escherichia* (Gaskins, 2000). It has been reported that about 11% of mortality rate in post weaning piglets were due to the incidence of diarrhea (Owusu-Asiedu et al., 2003). The application of *Saccharomyces cerevisiae* fermented product for weaned pigs during *Salmonella* infection, had a positive effect on improved growth performance (Price et al., 2010).

In view of *Saccharomyces cerevisiae* advantages in swine, the aim at the present study was to investigate the effect of brewer's yeast (*Saccharomyces cerevisiae*) supplementation on growth performance, nutrient digestibility and fecal score of growing pigs.

Materials and methods

Preparation of brewer's yeast hydrolysate (*Saccharomyces cerevisiae*)

The brewer's yeast used in the experiment was provided by Plantinum Brewery company (Seoul, Korea). The hydrolysated brewer's yeast production contains 4,240 kcal·kg^{-1} digestible energy (DE), 53.2% crude protein (CP), 1.8% crude fat (ether extract), 5.2% ash. The main compounds of brewer's yeast hydrolysate are presented in Table 1.

Table 1. Composition of brewer's yeast. (continued)

Items	Brewer's yeast (%)
Digestible energy (kcal·kg^{-1})	4,240
Crude protein	53.20
Crude fat	1.80
Crude fiber	0.80
Ash	5.20
Moisture	6.80
Amino acids	
Arginine	2.30
Histidine	1.50
Isoleucine	2.36
Leucine	2.96
Lysine	3.20
Methionine	0.88
Cysteine	0.53
Total sulfur-containing amino acids	1.20

Table 1. Composition of brewer's yeast.

Items	Brewer's yeast (%)
Vitamin B complex	
Thiamin	3.50
Riboflavin	4.50
Niacin	30.00
Vitamin B_6	2.30
Folate	0.13
Vitamin B_{12} (μg)	0.40
Mineral	
Calcium	0.15
Phosphorus	1.11
Potassium	1.48
Chlorine	0.10
Magnesium	0.33
Sodium	0.08
Selsnium (ppm)	0.91

Animals, experiment design, diets and facilities

In total 60 pigs (Duroc × [Landrace × Yorkshire]) with an average 25.50 ± 1.63 kg were selected and randomly allotted to two treatment groups with 6 replications of 5 pig per replicate pen for each treatment. The experiment treatments were as follows: 1) control basal diet (CON); 2) 1.00% brewer's yeast, basal diet with 1.00% brewer's yeast. The diets were based on the nutrient requirements recommended by NRC (2012) (Table 2). They were fed treatment diet for 6 weeks. Pigs were housed in environmentally controlled rooms at 23 ± 1℃, each pen provided a self-feeder and nipple drinker.

Table 2. Composition of the experimental growing diets (as-fed-basis). (continued)

Ingredients (%)	Grower
Corn	45.06
wheat	13.00
Soybean meal	23.00
Rapeseed meal	2.20
Distillers dried grains with solubles	5.00
Dibasic calcium phosphate	1.06
Limestone	1.00
Salt	0.30
L-lysine 51%	0.24
DL-Methionine 50%	0.12
L-Tryptophan 10%	0.01
L-Threonine 98.5%	0.13
Animal Fat	5.30
Molasses	3.20
Choline 50%	0.08
Vitamin premix[x]	0.15
Mineral premix[y]	0.15

Table 2. Composition of the experimental growing diets (as-fed-basis).

Ingredients (%)	Grower
Calculated composition	
Metabolizable energy ($kcal \cdot kg^{-1}$)	3,400
Crude protein (%)	17.50
Lysine	0.95
Methionine	0.30
Calcium (%)	0.76
Available phosphorus (%)	0.28

[x] The vitamin and mineral premix supplied per 1kg 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.
[y] 25 mg of Cu from $CuSO_4.5H_2O$, 250 mg Fe from $FeSO_4.7H_2O$, 70 mg of Mn from MnO_2, 58 mg of Zn from $ZnSO_4$, 0.2 mg of Se from $Na_2SeO_3.5H_2O$, 0.3 mg of Co from $CoSO_4.7H_2O$.

Sampling and measurement

The individual body weight (BW) of pigs and feed consumption from each pen were determined at the start, week 4 and week 6 of the experiment to calculate the average daily gain (ADG), average daily feed intake (ADFI), and gain : feed ratio (G/F). Chromium oxide (Cr_2O_3) was added to the diet at 0.2% of the diet as an indigestible marker for 7 days prior to fecal collection on weeks 6 to calculate dry matter (DM), nitrogen (N) and energy. Fecal score based on the standard of 5 grade score system: 1-standing for hard, dry pellets in a small, hard mass, 2-hard formed stool that remains firm and soft, 3-soft formed and moist stool that retains its shape, 4-soft unformed stool that assumes the shape of the container, 5-watery liquid stool that can be poured (Hu et al., 2012). The fecal score was determined as the average value of five pigs of each pen.

Data analysis

All data obtained in the current study were analyzed in accordance with a completely randomized block design 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 a probability level of $p < 0.05$ was considered statistically significant.

Results

Growth performance

Dietary supplementation with brewer's yeast led to a significant improvement ($p < 0.05$) in BW at weeks 4 and 6, and higher ADG and G/F during week 4 and overall compared with CON, however, ADFI remained unaffected (Table 3).

Table 3. Effect of brewer's yeast on growth performance in growing pigs.

Items	CON	Brewer's yeast	SEM	p-value
Body weight (kg)				
Initial	25.49	25.52	0.01	0.6045
Week 4	43.97b	45.30a	0.31	0.0472
Week 6	54.44b	56.28a	0.47	0.0304
Week 4				
ADG (g)	660b	707a	11.39	0.0436
ADFI (g)	1,444	1,486	27.35	0.5974
G/F	0.457	0.475	0.029	0.0827
Week 6				
ADG (g)	748	784	14.38	0.0873
ADFI (g)	1,658	1,682	37.35	0.7824
G/F	0.451	0.466	0.051	0.3746
Overall				
ADG (g)	689b	732a	11.39	0.0435
ADFI (g)	1,515	1,551	25.12	0.5011
G/F	0.455	0.471	0.028	0.1264

CON, the control; Brewer's yeast, 1.00% Brewer's yeast; SEM, standard error of means; ADG, average daily gain; ADFI, average daily feed intake; G/F, gain : feed ratio.
a, b: Means in the same row with different superscript differ significantly ($p < 0.5$).

Nutrient digestibility

The effect of brewer's yeast supplementation on the apparent total tract digestibility (ATTD) of DM, N and energy is shown in Table 4. Compared with CON, brewer's yeast supplementation increased the ATTD of DM ($p < 0.05$), also no effected on N and energy digestibility.

Table 4. Effect of brewer's yeast on nutrient digestibility in growing pigs.

Items (%)	CON	Brewer's yeast	SEM	p-value
Week 6				
Dry matter	75.14	76.79	0.64	0.043
Nitrogen	73.71	74.05	0.46	0.041
Energy	74.86	75.43	0.66	0.6558

CON, the control; Brewer's yeast, 1.00% Brewer's yeast; SEM, standard error of means.

Fecal score

The fecal score in pigs was not affected with brewer's yeast supplementation compared with those fed control diet (Table 5).

Table 5. Effect of brewer's yeast on fecal score in growing pigs.

Items (%)	CON	Brewer's yeast	SEM	p-value
Fecal score[z]				
Initial	3.39	3.39	0.042	0.8879
Week2	3.31	3.29	0.034	0.8475
Week3	3.30	3.27	0.033	0.8524
Week4	3.18	3.32	0.042	0.2697
Week5	3.23	3.27	0.045	0.4226
Finish	3.20	3.25	0.053	0.5461

CON, the control; Brewer's yeast, 1.00% Brewer's yeast; SEM, standard error of means.
[z] Fecal scores were determined at 08:00 and 20:00 using the following fecal scoring system: 1 hard, dry pellet; 2 firm, formed stool; 3 soft, moist stool that retains shape; 4 soft, unformed stool that assumes shape of container; 5 watery,liquid that can be poured.

Discussion

Studies involving yeast products have reported increased growth performance of nursery pigs (Shen et al., 2009), improved ADG in weaned piglets (Liu et al., 2018). This shows that *Saccharomyces cerevisiae* supplementation in pig diet has positive effect of growth performance (Shen et al., 2009). In the present study also, the ADG and G/F was improved on pigs receiving brewer's yeast supplemented diet. So, these results showed that brewer's yeast supplementd in the diet not only promoted the growth of weaning pigs, but also promoted the growth of growing pigs. Yeast derivatives typically contain a complex of manna oligosaccharides (MOS), polysaccharides and β-glucans (Hasan et al., 2018). These polysaccharides not only interact directly with immune cells (Ruiz-Herrera, 2016), and also had positive effects on feed intake (Hiss and Sauerwein, 2003; Sauerwein et al., 2007). Although there was no significant difference on ADFI, but the performance tends to increase during the experiment. The variable response to yeast could be due to dose of yeast, types of yeast strain used for preparing the extract, procedure for animal physiological status and farm conditions.

The ATTD not only reflects the utilization of nutrients, but also reflects the growth performance of growing pigs. Shen et al. (2009) demonstrated that the supplementation of yeast in weaning pigs' diet, improved digestibility of DM. Digestibility measurements were made at the fecal level, and therefore, through absorption and bacterial assimilation of nutrients in the small and large intestine calculations include disappearance of nutrients. Van Heugten et al. (2003) reported that yeast supplementation had a positive effect on pig digestibility. But from this data, the total tract digestibility no significant effect, and the result was similar with Pinloche et al. (2012). Liu et al. (2018) and Li et al. (2019) reported that supplementation with yeast cultures on weaning pigs, the total tract digestibility also has no significant difference. It may the microbiota have relatively stable due to the age of pigs in our experiment. So a suitable dose of yeast may require to initiate a shift in the microbiota.

Collier et al. (2011) reported oral administration of *Saccharomyces cerevisiae* reduced mortality for infected *E. coli* in weaned piglets. Polysaccharides were the major components of yeast and yeast cell wall products (Kogan and Kocher, 2007). Polysaccharides not only interacted directly with immune cells, but also were able to bind bacteria to prevent attachment and colonization of pathogens in the gastrointestinal tract (Broadway et al., 2015; Ruiz-Herrera, 2016). So, yeast had positive effects on improved intestinal microbiota and preventd diarrhea. Although there was no significant difference in fecal score compared with the control group in this experiment, but there was a tendency to improve fecal matter in our experiment, which may relate to the relative stability of intestinal microorganisms in the experimental animal group.

Conclusions

In conclusion, results indicated that dietary supplementation of brewer's yeast can improve growth performance in growing pigs. Supplementation of brewer's yeast in the diet of growing pigs had no significant on digestibility and fecal score.

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References

Bontempo V, Di Giancamillo A, Savoini G, Dell'Orto V, Domeneghini C. 2006. Live yeast dietary supplementation acts upon intestinal morpho-functional aspects and growth in weanling piglets. Animal Feed Science and Technology 129:224-236.

Broadway P, Carroll J, Sanchez N. 2015. Live yeast and yeast cell wall supplements enhance immune function and performance in food-producing livestock: A review. Microorganisms 3:417-427.

Collier C, Carroll J, Ballou M, Starkey J, Sparks J. 2011. Oral administration of *Saccharomyces cerevisiae boulardii* reduces mortality associated with immune and cortisol responses to *Escherichia coli* endotoxin in pigs. Journal of Animal Science 89:52-58.

Gaskins HR. 2000. Intestinal bacteria and their influence on swine growth. In Swine nutrition, Second Edition. pp. 586-609. CRC Press, Boca Raton, FL, USA.

Hasan S, Junnikkala S, Peltoniemi O, Paulin L, Lyyski A, Vuorenmaa J, Oliviero C. 2018. Dietary supplementation with yeast hydrolysate in pregnancy influences colostrum yield and gut microbiota of sows and piglets after birth. PloS one 13:e0197586.

Hiss S, Sauerwein H. 2003. Influence of dietary *β*-glucan on growth performance, lymphocyte proliferation, specific immune response and haptoglobin plasma concentrations in pigs. Journal of animal physiology and animal nutrition 87:2-11.

Hu C, Gu L, Luan Z, Song J, Zhu K. 2012. Effects of montmorillonite–zinc oxide hybrid on performance, diarrhea, intestinal permeability and morphology of weanling pigs. Animal Feed Science and Technology 177:108-115.

Jiang Z, Wei S, Wang Z, Zhu C, Hu S, Zheng C, Hu Y, Wang L, Ma X. 2015. Effects of different forms of yeast Saccharomyces cerevisiae on growth performance, intestinal development, and systemic immunity in early-weaned piglets. Journal of Animal Science and Biotechnology 6:47.

Kogan G, Kocher A. 2007. Role of yeast cell wall polysaccharides in pig nutrition and health protection. Livestock Science 109:161-165.

Li Y, Li T, Kim I. 2019. Effect of the Yea-Sacc yeast culture on growth performance, nutrient digestibility and fecal score in weanling pigs. Korean Journal of Agricultural Science 46:229-237.

Liu X, Lee D, Sun H, Park J, Kim I. 2018. Effects of yeast culture (*Saccharomyces cerevisiae)* supplementation on growth performance, fecal score, and nutrient digestibility of weaning pigs. Journal of Animal Science 96:48-49.

NRC (National Research Council). 2012. Nutrient requirements of swine, 11th Ed. National Academy Press, Washington, D.C., USA.

Owusu-Asiedu A, Nyachoti C, Marquardt R. 2003. Response of early-weaned pigs to an enterotoxigenic escherichia coli (k88) challenge when fed diets containing spray-dried porcine plasma or pea protein isolate plus egg yolk antibody, zinc oxide, fumaric acid, or antibiotic. Journal of Animal Science 81:1790-1798.

Pinloche E, Williams M, D'Inca R, Auclair E, Newbold C. 2012. Use of a colon simulation technique to assess the effect of live yeast on fermentation parameters and microbiota of the colon of pig. Journal of Animal Science 90:353-355.

Price K, Totty H, Lee H, Utt M, Fitzner G, Yoon I, Ponder MA, Escobar J. 2010. Use of saccharomyces cerevisiae fermentation product on growth performance and microbiota of weaned pigs during salmonella infection. Journal of Animal Science 88:3896-3908.

Reed G, Nagodawithana TW. 1991. Wine yeasts. In Yeast technology. pp. 151-224. Van Nostrand Reinhold, New York, USA.

Ruiz-Herrera J. 2016. Fungal cell wall: Structure, synthesis, and assembly. CRC press, Boca Raton, Ann Arbor, London, UK.

SAS Institute. 1996. SAS user's guide: Statistics. Version 7.0. SAS Institute, Cary, NC, USA.

Sauerwein H, Schmitz S, Hiss S. 2007. Effects of a dietary application of a yeast cell wall extract on innate and acquired immunity, on oxidative status and growth performance in weanling piglets and on the ileal epithelium in fattened pigs. Journal of Animal Physiology and Animal Nutrition 91:369-380.

Shen Y, Carroll J, Yoon I, Mateo R, Kim S. 2011. Effects of supplementing saccharomyces cerevisiae fermentation product in sow diets on performance of sows and nursing piglets. Journal of Animal Science 89:2462-2471.

Shen Y, Piao X, Kim S, Wang L, Liu P, Yoon I, Zhen YG. 2009. Effects of yeast culture supplementation on growth performance, intestinal health, and immune response of nursery pigs. Journal of Animal Science 87:2614-2624.

Van Heugten E, Funderburke D, Dorton K. 2003. Growth performance, nutrient digestibility, and fecal microflora in weanling pigs fed live yeast. Journal of Animal Science 81:1004-1012.