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Annual Swine Report 2001

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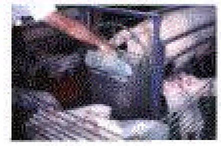

Nutrition

EFFECTS OF LIVE YEAST SUPPLEMENTATION ON WEANLING PIG PERFORMANCE

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Summary
Effects of yeast supplementation to diets with or without an antibiotic and high levels of copper and zinc on nursery pig performance were evaluated. Yeast supplementation appeared to work in concert with the other growth promotants (zinc, copper, and antibiotics) used in this experiment. Supplementation of yeast to diets containing these growth promotants improved pig growth performance resulting in pigs that were 2 kg heavier than control pigs after the 6 week nursery period. However, yeast supplementation was not effective in improving pig performance in diets without zinc, copper, and antibiotic as growth promotants. Based on these results, yeast supplementation to diets used in current commercial pig production appears to be an effective strategy to improve pig performance.

Introduction
Probiotics, such as yeast, have the ability to stimulate digestion and aid in maintaining microbial equilibrium in the gut. Live yeast, such as *Saccharomyces cerevisiae*, contains numerous enzymes that could be released into the intestine and aid existing enzymes in the digestive tract in the digestion of feed. In addition, yeast contains vitamins and other nutrients that may produce beneficial production responses (Kornegay et al., 1995). In monogastrics, research conducted to test the effectiveness of yeast cultures on performance is limited and variable (Kornegay et al., 1995; Jurgens et al., 1997; Mathew et al., 1998). Therefore, the objective of this experiment was to test the effects of yeast supplementation at 10^7 colony-forming units per gram of feed (cfu/g) on nursery pig performance. In addition, the effects of yeast supplementation in diets with or without pharmacological levels of copper, zinc, and antibiotics were studied to determine if yeast could provide benefits similar to growth promotants, or if it could act in concert with these ingredients.

Materials and Methods
Ninety-six pigs were weaned at seventeen days of age. Pigs were housed four pigs per pen, using a total of 24 pens in one room. Each pen had slatted floors and was equipped with a watering device and feeder, which allowed pigs ad libitum access to water and feed. The pigs were allotted to one of four dietary treatments based on initial weight and litter origin. There were six pens per treatment and a total of twenty-four pigs per treatment. Dietary treatments were: 1) Industry type diet (containing growth promoting levels of zinc, copper, and antibiotic); 2) Industry type diet with yeast

(BIOSAF®); 3) Negative control (diet without high levels of zinc, copper, and antibiotic); and 4) Negative control with yeast. Pigs were housed in an environmentally controlled nursery with a forced air ventilation system. Initial temperature in the nursery was 27^{o}C and was lowered 1^{o}C weekly. The nursery was not cleaned prior to the experiment to provide a more challenging environment to the pigs. Pigs were fed three diet phases (prestarter, starter 1, and starter 2) in 2-week intervals (Table 1). Pig weights and feed consumption were measured on a weekly basis for six weeks. Data were analyzed using the GLM procedure of SAS (1998). The model included block, diet type, yeast supplementation and the diet type by yeast supplementation interaction.

Table 1: Composition of negative control diets*

	Prestarter	**Starter 1**	**Starter 2**
Corn	41.20	52.13	60.09
Soybean Meal	22.00	32.06	32.30
Poultry Fat	4.0	4.0	4.0
Whey	21.43	6.43	0
Plasma Protein	2.75	0	0
Fish Meal	6.85	2.5	0
Dicalcium Phosphate	0.40	1.14	1.67

[1]Aureomycin 50 (400 g/ton of CTC) and Denaguard 10 (35 g/ton of tiamulin) were used in the appropriate prestarter diets and Tylan 40 Sulfa G (100 g/ton of tylosin/sulfamethazine) was used in the appropriate Starter 1 and Starter 2 diets.

Results and Discussion
Diet analysis confirmed within reasonable limits that the diets contained the specified amounts of nutrients and minerals targeted. Yeast cell counts in the feed were also measured (in starter 1 and 2 diets) to determine if the proper level of yeast was added to the diet and if the yeast survived pelleting (Table 2). Yeast counts were within specified limits and pelleting did not decrease yeast counts, indicating that yeast survived pelleting.

Table 2. Live yeast counts of starter 1 and starter 2 diets[a]

	Commercial Diet		Negative Control	
Item	**- yeast**	**+ yeast**	**- yeast**	**+ yeast**
Starter 1				
Mash	3.96	7.78	4.08	7.66
Pellet	1.90	7.32	1.90	7.63
Starter 2				
Mash	2500	7.40	3.47	8.04
Pellet	3.40	7.43	1.00	7.20

[a]Expressed as $\log_{10}$(cfu/g). Yeast counts were determined by SAF products on diets before pelleting (mash) and after pelleting (pellet).

As part of standard operating procedures, several pigs were treated with antibiotics (injection) because they appeared unthrifty and one pig was treated for a swollen joint. Total number of days that pigs were treated with antibiotics were 14, 3, 0, and 3 for dietary treatments 1 to 4, respectively. This included the pig that was treated for 3 days for a swollen joint (dietary treatment 2). Analysis of the overall daily gain data identified 4 pigs that had daily gains that were more than 2 standard deviations below the mean daily gain of all pigs and could, therefore, be considered outliers. All 4 pigs had been fed the commercial type diet without supplemental yeast (diet 1). Therefore, the fact that these pigs grew poorly appeared to be related to diet, rather than being a random occurrence. For that reason, these pigs were not removed from the data analysis.

There was a significant interaction ($P < 0.05$) between diet type and yeast supplementation in affecting body weights. Pigs fed diets that contained growth promoting levels of zinc, copper and antibiotics and were supplemented with yeast were 2.12 kg heavier ($P < 0.001$) at the end of the experimental period than pigs not supplemented with yeast. Supplementation of yeast to the negative control diets did not improve final weights of pigs ($P > 0.80$). Average daily gain for week 2 to 4 ($P < 0.05$), week 4 to 6 (P < 0.05), and overall (P < 0.01) was greater for pigs receiving yeast supplementation in industry type diets compared to those not receiving yeast. However, supplementation of yeast to negative control diets did not affect daily gain. The improvement in daily gain observed in pigs fed the commercial type diets with yeast was partly related to an increased feed intake in these pigs during week 2 to 4 (P < 0.01), and a tendency for improved intake for the overall experimental period (P < 0.10). Feed efficiency (gain/feed) tended to be improved in pigs fed commercial type diets with yeast compared to those not fed yeast only during week 1 (P < 0.10). Addition of zinc, copper and antibiotics to the diet resulted in an improvement in feed efficiency during week 0 to 2 (P < 0.05). Collectively, the results of this experiment suggest that the addition of growth promoting levels of zinc, copper and antibiotics improved pig growth performance and that supplementation of yeast was effective in further enhancing this response. However, yeast supplementation did not appear to improve pig growth performance when supplemented to diets without growth promoting levels of zinc, copper, and antibiotics.

Table 3. Performance of pigs fed different diet types with or without yeast[a]

	Commercial diet		**Negative Control**		**Standard**	**P value[1]**		
Item	**- yeast**	**+ yeast**	**- yeast**	**+ yeast**	**Error**	**Diet**	**Yeast**	**D x Y**
Body Weight, kg								
Week 0	6.52	6.49	6.50	6.50	0.02	0.725	0.299	0.484
Week 1	7.13	7.43	7.34	7.23	0.12	0.950	0.438	0.108
Week 2	9.10	9.70	8.76	8.79	0.27	0.034	0.258	0.310
Week 3	11.96	13.43	11.70	11.78	0.26	0.002	0.009	0.018
Week 4	15.91	17.63	15.69	15.94	0.30	0.005	0.005	0.026
Week 5	21.36	22.89	20.44	20.12	0.25	0.001	0.030	0.003
Week 6	26.69	28.81	25.91	25.79	0.35	0.001	0.013	0.006
Daily gain, g/d								
Week 0-2	184	229	161	164	19	0.034	0.226	0.284
Week 2-4	487	567	495	510	12	0.059	0.001	0.015
Week 4-6	732	798	728	704	16	0.009	0.219	0.014
Overall	480	531	462	459	8	0.001	0.010	0.006
Feed Intake, g/d								
Week 0-2	236	266	224	241	15	0.236	0.141	0.663
Week 2-4	626	721	683	671	17	0.871	0.029	0.007
Week 4-6	1143	1179	1072	1029	41	0.016	0.942	0.345
Overall	660	722	654	647	18	0.037	0.143	0.073
Gain/Feed, g/g								
Week 0-2	0.757	0.859	0.713	0.680	0.040	0.013	0.395	0.108
Week 2-4	0.778	0.786	0.729	0.762	0.021	0.103	0.362	0.561
Week 4-6	0.641	0.677	0.685	0.685	0.017	0.145	0.309	0.297
Overall	0.730	0.736	0.709	0.710	0.013	0.103	0.814	0.863

[a]Data are an average of six pens (4 pigs per pen) per treatment.
[1]P values for main effects of diet type, yeast supplementation, and their interaction, respectively

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