The Effect of *Aspergillus oryzae* on Performance of Swine

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ABSTRACT

An experiment was conducted focusing on the effects of *Aspergillius oryzae* (Amaferm®) on maternal and growth traits of swine. In stage one, sixty-one sows were assigned to either a group receiving 0.046 oz/d of *Aspergillius oryzae* top dress on the sow feed daily or to a control group which did not receive *Aspergillius oryzae*. Feed intake, body condition, return to estrus, piglet weaning weight, piglet gain, and piglet average daily gain were observed. Treatment showed no significant effect on feed intake, body condition, piglet weaning weight, or return to estrus of sows. There was a significant negative effect on piglet gain (P<0.01). Stage two utilized piglets (N=412) from stage one. Piglets reared from treatment sows received Amaferm®, and piglets reared from control sows received the control diet. Treatment and control were fed *ad libitum*, and treatment received *Aspergillus oryzae* at the rate of 0.024 oz/lbs of feed. Weight gain, average daily gain, feed intake, and feed-to-gain ratio were measured. Treatment had no significant effect on all observations. Amaferm® had no positive effect on maternal or growth factors in swine.

KEYWORDS: *Aspergillus oryzae*, Amaferm®, Monogastric Probiotic, Feed Additive, Average Daily Gain.

INTRODUCTION

The animal feeding industry is competitive industry with tight profit margins. Increasing costs of production coupled with a continuous search for products that increase production has drastically improved efficiency in all sectors of the livestock industry.

The product known as Amaferm® was discovered in 1945 during WWII by the chemist H.E. Kistner. In order to support the war effort, Kistner was using a culture of *Aspergillus oryzae* to extract more alcohol from grain used in manufacturing aviation fuel. The used mash, which was a result of the fermentation process, was fed to ruminant livestock. Greater growth rates were observed in the animals fed the product.

There has been research that suggests *Aspergillus oryzae* promotes microbial growth in ruminants (Beharka and Nagaraja, 1991; Yoon and Stern, 1996; Denigan et al., 1992 and Gomez-Alarcon et al., 1991). This increase in the density of the microflora of the rumen has been attributed to the increased degradation of fiber in the diet (Weimer, 1998). Increased degradation of fiber has helped increase weight-per-day-of-age and feed efficiency in ruminants (Bodine and Purvis II, 2003). However, there are no peer reviewed articles that have observed the effects of Amaferm® on non-ruminant digestion and translation into improved maternal and growth efficiency. Therefore, the objective of this study was to determine the effects of *Aspergillus oryzae* (Amaferm®) on performance of swine. This study focused on reproduction efficiency, growth, and growth efficiency.

MATERIALS AND METHODS

The experiment was divided into two stages that included maternal performance of lactating sows and growth efficiency of nursery pigs. The experiment was designed to mimic modern commercial swine operations.

Stage One

Sixty-one Yorkshire, Hampshire, and Duroc crossbred sows were randomly assigned into two groups (31 treatment and 30 control) as they entered the farrowing house.

The treatment group was hand fed 0.046 ounces of Amaferm® per day as a top dress, using 1 ounce wheat bran as a carrier. The control group received the same lactation diet and was fed a placebo of 1 ounce of wheat bran.

Table1. Lactation Diet Analysis

Component	Percent of Diet
Protein, %	15.9
Lysine, %	0.98
Fat, %	2.8
Calcium, %	1.22
Phosphorus, %	0.88

The lactation diet included soybean meal, corn, and a commercial sow mineral package (Table I). Two weeks prior to farrowing, sows were selected at random. There were five farrowings conducted throughout the year. At each farrowing, they were evenly assigned either treatment or control. Breed, size, parity and age was not used as selection criteria. It was strictly at random. Beginning and ending body condition score and daily feed intake of each sow was measured. Beginning body condition was recorded when sows were placed into farrowing crates. Ending body condition was taken when piglets were weaned and sows were removed from farrowing crates. A three-person panel performed body condition scoring, and the average of the three was recorded. A one to nine point scale was used with one indicating an emaciated condition and nine indicating an obese condition.

Four hundred fifteen pigs were born in the study of which 219 were born from treatment sows and 196 were born from control sows. Number of piglets born alive and weaned were recorded at the beginning and the end of stage one. Birth and weaning weights (adjusted to 21 days) were measured on digital platform scales and recorded. Adjustments were calculated utilizing formulas from (Boggs, etal., 1998). After weaning, sows were returned to the breeding/gestation facility, where they were observed twice daily for signs of estrus.

Stage Two

Four hundred twelve mixed Yorkshire, Hampshire, and Duroc crossbred nursery pigs were assigned to one of two groups (treatment or control) based on their dam's diet from stage one.

Table2. Nursery Pig Diet Analysis

Component	Percent of Diet
Protein, %	20.0
Lysine, %	1.9
Fat, %	8.0
Fiber, %	1.2
Calcium, %	1.4
Phosphorus, %	1.3

The treatment ration contained Amaferm® (0.024 oz per lbs of feed). The base ration was commercially available (ADM Alliance Nutrition, Quincy, Illinois), and was fed on an *ad libitum* basis (Table II).

There were four different feeding replications, which were split evenly between treatment and control. As each group of sows completed stage one, the progeny from the treatment sows were assigned the treatment group, and the progeny from the control sows were assigned the control group. The nursery facility contained eight 6 ft × 6 ft pens and had a capacity of twelve pigs per pen. Piglets were weaned, weighed, and placed in the nursery. The study was conducted for a period of thirty days at which time the animals were weighed on digital platform scales and moved to the finishing floor. Data collected for the nursery pigs included: beginning weight, ending weight, total weight gained, average daily gain, total feed intake for each group, and feed-to-gain ratio for each group.

The General Linear Model procedure of SAS (Statistical Analysis Software; of Cary, North Carolina) was used to analyze all data. Least square means were used to compile and separate means. The model contained the effect of treatment. A confidence level of 95 percent ($P<0.05$) was considered significant, and a confidence level of 99 percent ($P<0.01$) was considered highly significant.

RESULTS

After data collection, information was organized in five tables which included: sow feed intake factors, sow maternal factors, piglet growth factors, nursery pig growth factors and nursery pig feed efficiency. There was no death loss among sow experimental units for either treatment or control, however, three nursery pigs perished and were removed from the experiment.

Stage One

The hypothesis was that Amaferm® would not have an effect on sow maternal traits. Table III displays data concerning sow feed intake and body condition change.

Table 3. Stage One Comparison of Lactating Sow Feed Intake Factors

Factor	Amaferm®	SE	Control	SE	P value
Sow Feed Intake, lb	12.60	2.48	14.23	1.83	P>0.1623
BCS change	-1.23	0.18	-0.85	0.19	P>0.1630

There was no significant difference ($P>0.1623$) between intake of the treatment group and the control group. The intake of the treatment group was 12.60 pounds per day, and the intake of the control group was 14.23 pounds per day.

Also, body condition score data was obtained at parturition and at weaning. Treatment had no significant effect ($P>0.1630$) on body condition. The mean difference in body condition score for the treatment group decreased by -1.23, and the control group decreased by -0.85.

Table 4. Stage One Comparison of Lactating Sow Maternal Factors

Factor	Amaferm®	SE	Control	SE	P value
Initial Litter Size	7.8	0.54	8.0	0.57	P>0.1769
Number Weaned per Litter	7.5	0.80	6.9	0.84	P>0.1127
Percent Weaned, %	96.5	3.68	85.8	4.19	P>0.1349
Return to Estrus, days	4.5	0.18	5.0	0.19	P>0.1318
Mortality Rate, %	3.5	3.68	14.2	4.19	P>0.1349

Table IV shows the comparison of maternal trait performance data. Initial litter size was not significantly affected by the treatment ($P>0.1769$). The initial litter size mean of the treatment group was 7.8 compared to 8.0 for the control group. The number

weaned was also not significantly affected by the treatment (P>0.1127). Similarly, the treatment group had a mean weaned litter size of 7.5 and the control group weaned 6.9 piglets. Calculations were conducted to derive the percentage of piglets born alive that survived until weaning. The treatment had no significant effect on percent weaned (P>0.1349). The treatment group had a weaning percentage of 96.5 percent compared to 85.8 percent weaned for the control group.

Upon completion of weaning data, the sows were observed for onset of estrus. The treatment had no significant effect on onset of estrus (P>0.1318). The mean number of days for return of estrus of the sows in the treatment group was 4.5 days, and the control group returned in 5.0 days to estrus.

Table 5. Stage One Comparison of Piglet Growth Factors

Factor	Amaferm®	SE	Control	SE	P value
Weaning Weights, lbs.	15.13	0.22	15.86	0.22	P>0.1490
Average Daily Gain, lbs./day	0.46	0.18	0.48	0.20	P>0.0904
Weight Gains, lbs.	9.54	0.51	10.28	0.49	P>0.0044

Table V displays piglet growth data. The treatment had no significant effect on piglet weaning weight (P>0.1490). The mean weaning weights for treatment and control were 15.13 pounds and 15.86 pounds, respectively. The treatment showed no significant effect on average daily gain from birth to weaning. The treatment group gained 0.46 pounds per day, and the control group gained at a rate of 0.48 pounds per day. However, the treatment had a highly significant negative effect on weight gains for birth to weaning (P>0.0044). The treatment group gained 9.54 pounds, and the control group gained 10.28 pounds.

Stage Two

The hypothesis was that Amaferm® would not affect gain in nursery piglets. Death losses were minimal with only two treatment nursery pigs and one control nursery pig perishing. These were removed from the study.

Table 6. Stage Two Comparison of Nursery Pig Growth Factors

Factor	Amaferm®	SE	Control	SE	P value
Average Daily Gain, lbs/day	0.77	0.42	0.81	0.40	P>0.1357
Total Weight Gain, lbs	22.40	0.57	24.22	0.53	P>0.0698

Table VI displays data collected on nursery pig growth. Weaning weights were assigned as beginning weights that were collected in stage one, and final weights were collected on day thirty post-weaning. The treatment had no significant effect on average daily gain (P>0.1357). The treatment group gained at a rate of 0.77 pounds per day, and the control group gained at the rate of 0.81 pounds per day. The treatment also had no

significant effect on total weight gained in the nursery (P>0.0698). The treatment group gained 22.90 pounds, and the control group gained 24.22 pounds.

Table 7. Stage Two Comparison of Nursery Pig Feed Efficiency Factors

Factor	Amaferm®	Control	P value
Ave. Feed Intake, lbs/day	0.55	0.56	NA*
Ave. Feed Conversion Ratio, lbs of feed/lbs of gain	1.59	1.55	NA*

**The total amount of feed was measured; however, the intake of each pig could not be measured*

Feed intake data was collected as group data because the experimental design did not allow for individual intake data, but rather group intake data. Therefore, P values could not be obtained for the data. However, means were obtained and calculations were conducted. Table VII compares feed intake and feed-to-gain ratio.

The feed intake for the treatment group was 1.21 pounds per day while feed intake for control was 1.23 pounds per day. This information allowed for the calculation of feed-to-gain ratios for each group. The treatment group established a ratio of 1.59 pounds of feed to one pound of gain, and the control group established a ratio of 1.55 kilogram of feed to one kilogram of gain.

CONCLUSIONS

The hypothesis that Amaferm® would not improve maternal efficiency was confirmed by this experiment. It is concluded that Amaferm® had no significant effect on sow feed intake and body condition score during lactation. Statistical analysis concluded that Amaferm® did not have a significant effect on onset of estrus after weaning. The most prohibitive problem in this experiment was the N value of the sows.

The hypothesis that Amaferm® would not improve growth economic traits in nursery pigs was confirmed by this experiment. There were no significant differences derived for average daily gain or total weight gained in nursery pigs. However, there was a tendency (P>0.0698) that control pigs gained more weight post-weaning and showed a difference in pre-weaning than did their treatment counterparts.

This study does not address change in fiber digestion or change in microflora of the gastrointestinal tract of monogastrics. Therefore, more studies need to be conducted to determine if microfloral promoters could increase microfloral populations and, subsequently, increase fiber digestion in swine. Other studies should also be conducted to determine if Amaferm® loses efficacy when it goes through the monogastric digestive tract. With the data collected to date, Amaferm® showed to have a negative or no effect on maternal or growth traits.

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