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Technical Literature

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Effect of feeding encapsulated butyric acid in nursery diets containing reduced lactose levels on the growth performance of nursery pigs[1]

High prices of milk products will have negative economic impacts to swine nursery operations.

Reduction in lactose levels for high-lactose nursery pig diets may negatively impact performance.

By adding encapsulated butyric acid at 500 ppm to high-lactose diets, it is possible to:

- *Partially replace high cost lactose in the diet with marginal effects on growth performance.*
- *Reduce the cost per weight gained.*

Butyric acid has been shown to improve feed efficiency with a lower cost per pound of gain.

Summary

This study evaluated the effects of feeding 500 ppm encapsulated butyric acid (EBA; 50% active ingredient content) on nursery pig diets with reducing levels of lactose on the growth performance of weaning pigs[2]. The study had six dietary treatments with different lactose levels and inclusion levels of encapsulated butyric acid. The study was carried out over a 42d study period using 12 replicates with 720 weaning pigs (12 ± 0.55 lb) in 72 pens. During the study period, the lactose levels in the PC were reduced on each dietary phase with no lactose used in phase 4. All pigs were fed a common diet in Phase 4 and no EBA was added. Pigs were housed in two rooms that had not been cleaned following cessation of the previous study, with ad libitum access to feed and water. PC had a 11.8 and 12% higher ($P \leq 0.05$) overall ADG and ADFI than the NC. All pigs fed EBA had a similar ($P > 0.05$) overall performance across lactose levels. EBA fed pigs had on average a lower ($P \leq 0.05$) overall ADG and ADFI (5.7 and 6.5%, respectively) than the PC, and a higher ($P \leq 0.05$) overall ADG and ADFI (6.8 and 6.1%, respectively) than the NC. There were no treatment effects ($P > 0.05$) for overall G:F. Study results suggest EBA can be used to partially replace lactose in pig nursery diets, which could lower diet cost given the high prices of milk products. It also shows EBA may improve the efficiency of pigs with lower lactose diets.

Introduction

Butyric acid is a short chain fatty acid (SCFA) typically produced by microbial fermentation of fiber in the hind gut of non-ruminants, where it is directly utilized as an energy source for colonocytes[3]. In the colon, butyric acid has been shown to improve mucosal proliferation, epithelial cell differentiation and the function of the colonic barrier[4,5,6]. The benefits of butyric acid in the colon have also been demonstrated in the small intestine[7,8,9]. However, due to the minimal fermentation occurring in the small intestine of non-ruminants, butyric acid needs to be added in the diet to show any effect[7,8,9].

Butyric acid is typically fed in the salt form with either calcium or sodium. However, the uncoated form of these dietary butyric salts is associated typically with a distinct odor that may lead to lowered intakes and manufacturing and handling challenges.

The development of novel encapsulating and coating procedures has been shown to reduce the associated distinctive odor. Specifically, the MicroPEARL® spray freezing process may reduce odor and provide a slower release of butyric acid in the gastrointestinal tract.

Dried whey, lactose and other milk co-products are commonly included in the diets of weaning piglets. Although the benefits of lactose on growth performance are well documented, these ingredients may be costly. Therefore, decreasing these ingredients in the diet without sacrificing performance may lead to increases in economic gains. Commercial feeding strategies using encapsulated butyric acid have suggested the potential to lower lactose levels in swine nursery diets without impairing performance. As a result, the objective of the study was to evaluate performance of pigs fed a reduced lactose diet with the inclusion of encapsulated butyric acid.

Encapsulated source of butyric acid in a MicroPEARL®.

Materials and Methods

The study was conducted at a large Midwest nursery research farm and contained 720 crossbred weaning pigs (PIC C29 × 359) approximately 20 days of age. Upon arrival at the research unit, pigs were weighed (12 ± 0.55 kg) and housed in two environmentally controlled rooms. Pigs were blocked on the basis of weight and sex and allotted within block to 72 pens and six dietary treatments in a randomized complete-block design. There were 12 replications (pens) per treatment with each pen containing 10 pigs (providing 3.0 ft^2/pig). Pens had slatted metal floors, one 4-hole self-feeder, and one nipple-cup waterer. Pigs were weighed individually at start and end (d 42), and every 7 days throughout the study period. The following experimental treatments were fed according during the first three phases of the nursery period:

Table 1. Description of dietary treatments.[1]

Treatments	Treatment Description[2]	EBA (1 lb/US ton)	Dietary lactose level per feeding phase, %			
			1 (7d)	2 (7d)	3 (14d)	4 (14d)[3]
PC	Positive Control	-	15	12	9	0
NC	Negative Control (PC -6% unit lactose)	-	9	6	3	0
EBA	PC + EBA	+	15	12	9	0
-1% lactose + EBA	PC -1% unit lactose + EBA	+	14	11	8	0
-3% lactose + EBA	PC -3% unit lactose + EBA	+	12	9	6	0
-6% lactose + EBA	PC -6% unit lactose + EBA	+	9	6	3	0

[1]Iso-caloric and nitrogenous diets were formulated to be similar in major minerals, and vitamin and trace mineral fortification.
[2]Dietary treatments were offered throughout phases 1 to 3.
[3]No lactose or EBA was included in Phase 4 diets.

Diets were pelleted and medicated with chlortetracycline (200 mg/lb) and tiamulin (17.5 mg/lb) and were formulated with zinc (909 mg/lb) and copper (120 mg/lb).

Results

Study results are shown in Table 2. In general, all treatments with EBA had a similar ($P > 0.05$) overall performance regardless of levels of lactose in the diet. Moreover, such treatments had a 6.8 and 6.1% higher ($P \leq 0.05$) overall ADG and ADFI compared to the NC, but a 5.7 and 6.5% lower ($P \leq 0.05$) overall ADG and ADFI, respectively, compared to the PC. Overall, there were no differences ($P > 0.05$) on G:F across treatments.

Table 2. Least square means for the effect of dietary treatment on the performance of weaning pigs.

Item	PC	NC	PC+EBA	PC-1%+EBA	PC-3%+EBA	PC-6%+EBA	SEM	*P*-value
Body weight, lb								
Start (d 0)	12.0	12.1	11.9	12.0	12.0	12.0	0.55	0.82
End of phase 3 (d 28)	37.3[a]	33.7[c]	34.8[bc]	35.9[ab]	35.5[b]	35.5[b]	0.44	0.03
End of study (d 42)	60.0[a]	54.5[c]	56.4[bc]	57.8[b]	57.5[b]	56.9[b]	0.44	0.001
Average daily gain, lb								
Day 0 to 28	1.01[a]	0.90[c]	0.93[bc]	0.97[ab]	0.95[b]	0.95[b]	0.015	<0.01
Overall (d 0 to 42)	1.14[a]	1.00[c]	1.05[b]	1.09[b]	1.08[b]	1.07[b]	0.014	<0.01
Average daily feed intake, lb								
Day 0 to 28	1.21[a]	1.07[d]	1.11[cd]	1.16[b]	1.12[bc]	1.11[cd]	0.016	<0.01
Overall (d 0 to 42)	1.41[a]	1.24[c]	1.30[b]	1.34[b]	1.30[b]	1.31[b]	0.019	<0.01
Gain:Feed								
Day 0 to 28	0.838[b]	0.841[b]	0.846[b]	0.840[b]	0.852[ab]	0.863[a]	0.0061	0.04
Overall (d 0 to 42)	0.811	0.812	0.813	0.814	0.830	0.815	0.0062	0.22

[abcd]Means with different superscript within a row differ ($P \leq 0.05$)

Conclusions

Multiple independent studies indicate age and the lactose level of the diet plays a role in the efficacy of butyric acid to provide benefits in the nursery. As a result, an optimum level of lactose combined with butyric acid is required to determine improvement of economic gains in nursery pigs. These results showed it may be possible to replace one percentage unit of lactose inclusion with the addition of encapsulated butyric acid during the first 28 days of the nursery period, with little or no effect on body weight.

Additionally, pigs fed diets with six percent lower lactose + encapsulated butyric acid grew six percent faster than the NC; therefore, the addition of encapsulated butyric acid can be economically attractive when prices of lactose and dried whey may increase. This study suggests EBA can be used to partially replace lactose in swine nursery diets.

Furthermore, this study also supported earlier study findings of adding encapsulated butyric acid to diets with lower lactose levels may result in a heavier pig at the end of the nursery phase. Encapsulated butyric acid may improve the efficiency of the pig by lowering the cost per pound of gain.

References

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