

Application of *Lactiplantibacillus plantarum* Probiotics in Swine Diets

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Probiotic strains of *Lactiplantibacillus plantarum* (*L. plantarum*; formerly *Lactobacillus plantarum*) have been used as probiotics in human nutrition and are often used for applications such as silage inoculants. While not as widely used as other strains of probiotics such as the spore forming *Bacillus sp.* probiotics, *L. plantarum* has been shown to provide some benefits when supplemented in nursery, grow-finish, and sow diets (Table 1). For example, *L. plantarum* supplementation in nursery pig diets has been found to improve growth performance and feed efficiency and is associated with improved measures of antioxidant status and immunity. In addition, reduced fecal levels of *E. coli* have found in nursery pigs supplemented with *L. plantarum*. In addition to benefits reported regarding *L. plantarum* supplementation in nursery pig diets, published studies in grow finish pigs have reported improved growth performance, increased nutrient digestibility and decreased fecal ammonia levels when pigs are fed an *L. plantarum* probiotic. From a gut health perspective, fecal markers of protein fermentation have also been found to be decreased with *L. plantarum* supplementation. In sows, *L. plantarum* supplementation during gestation and lactation has been associated with reduced piglet pre-weaning mortality and improved piglet growth rates.

Table 1. Benefits observed in pigs fed diets supplemented with *L. plantarum* probiotics

Stage of Production	Benefits	Reference
Nursery	<ul style="list-style-type: none"> ↑ ADG & ADFI ↓ feed/gain ↑ antioxidant enzyme activity (superoxide dismutase & glutathione peroxidase) 	Wang et al., 2012
	<ul style="list-style-type: none"> ↑ ADG before and after challenge with K88+ <i>E. coli</i> ↑ ADFI and Gain/Feed after <i>E. coli</i> challenge ↓ pigs positive for <i>E. coli</i> ↓ duration of elevated serum cytokines 	Lee et al., 2012
	<ul style="list-style-type: none"> ↑ ADG, ADFI & Gain/Feed before and after K88+ <i>E. coli</i> challenge ↓ diarrhea ↑ intestinal barrier function and improve intestinal morphology 	Yang et al., 2014
	Tended to ↓ Feed/Gain in late nursery period	Jones et al., 2016
	↓ Feed/Gain in low complex nursery diets	Jones et al., 2016
	<ul style="list-style-type: none"> ↑ digestibility of dry matter, energy, nitrogen, fat, Ca, & P in non-medicated diets ↑ serum antioxidant enzyme activity (superoxide dismutase, catalase, & glutathione peroxidase) ↓ serum MDA 	Cui et al., 2019
	<ul style="list-style-type: none"> ↑ ADG & final body weight ↓ Feed/Gain ↑ serum IgA 	Betancur et al., 2020
	<ul style="list-style-type: none"> ↑ADG & ADFI ↑ final body weight ↑digestibility of DM, N, and energy ↓ fecal <i>E. coli</i> 	Yang et al., 2020
	<ul style="list-style-type: none"> ↑ADG, ADFI, & Gain/Feed ↑ final body weight 	Wang and Kim 2021

	↑ fecal <i>Lactobacillus</i> ↓ fecal <i>E. coli</i>	
	↑ ADG, ADFI, and FCR; ↑ small intestine villus: crypt ratio, ↑ hepatic antioxidant enzymes (superoxide dismutase & glutathione peroxidase)	Yu et al., 2024
Grow Finish	↓ fecal markers of protein fermentation	O'Shea et al., 2012
	↑ ADG & Gain/Feed ↑ fecal <i>Lactobacillus</i> ↑ dry matter digestibility ↓ manure ammonia	Hu et al., 2022
Sows	↓ pre-weaning mortality ↑ milk lactose & milk density ↑ piglet growth rate ↓ piglet diarrhea ↑ circulating lymphocytes, leucocytes and platelets in piglets	Betancur et al., 2021

EFFICOR™, A Novel *L. plantarum* Strain and Benefits of Supplementing Grow Finish Diets

Although most of data reported regarding benefits of *L. plantarum* supplementation are in nursery pigs, there are more data emerging regarding the benefits of supplementing *L. plantarum* probiotics to grow finish diets. In a series of three studies conducted in grow finish pigs it was observed that supplementing diets with a novel *L. plantarum* probiotic strain, which was originally isolated from swine (EFFICOR™; *L. plantarum* ATCC PTA-127487), improved feed efficiency and tended to improve average daily gain (Table 2). The diets used in the studies were corn-soy-DDGS based and formulated to the requirements of the genetic lines of swine used in the studies.

Table 2. Effects of supplementing grow finish diets with *L. plantarum* (EFFICOR) in 3 independent studies conducted by the Kent Nutrition Group on performance evaluated using a mixed model¹.

Variable	Control	EFFICOR (10 ⁵ cfu/g)	SEM	P-value
ADG, lb	1.802	1.834	0.024	0.15
ADFI, lb	5.072	5.057	2.057	0.77
Feed/Gain	2.817	2.761	0.090	0.05
Initial BW, lb	39.25	39.07	2.04	0.75
Final BW, lb	251.71	256.62	3.32	0.19
Mortality, %	2.47	1.72	0.69	0.39
Backfat, in	0.562	0.573	0.063	0.19
Loin depth, in	2.492	2.481	0.052	0.49
Lean, %	55.36	55.24	0.34	0.10

¹Data pooled across 3 independent studies with 26 replicate pens for the negative control and 25 replicate pens for the EFFICOR treatment group. Pens initially contained 16 to 20 pigs/pen. A linear-mixed model considered EFFICOR as the fixed effect and nested random effects across study and replicate using the lmer function from the lme4 package of R.

In a small study conducted in growing pigs it was observed that supplementing diets with *L. plantarum* (EFFICOR; 10⁵ CFU/g) for a period of 35 days was associated with changes in the fecal microbiota (Figure 1). The relative abundance of *Lactobacillus* tended to be increased, and *Clostridium* was significantly decreased. Interestingly, the relative abundance of *Ruminococcus*, which has been associated with the breakdown of fiber, was increased in pigs fed diets supplemented with the *L. plantarum* probiotic.

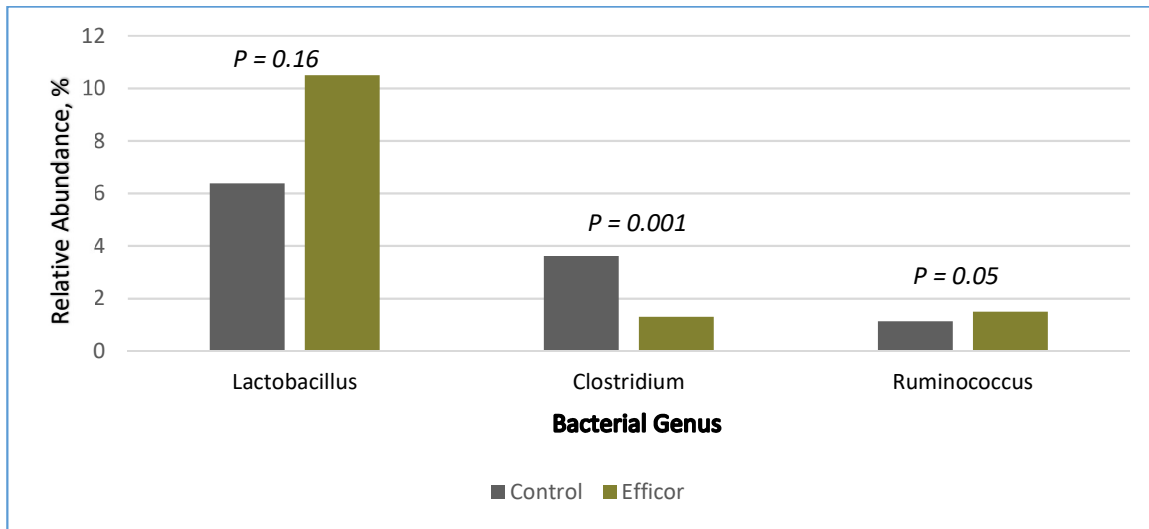


Figure 1. Effect of *L. plantarum* (EFFICOR) supplementation on the relative abundance of select fecal bacterial populations.

In summary, supplementing swine diets with *L. plantarum* probiotics has been associated with benefits such as improved growth performance, improved feed efficiency and improved measures of antioxidant status and immunity. In addition, some beneficial effects on the profile of the microbiota have been reported. Although most studies have been conducted in nursery pigs, emerging data are finding that supplementing grow finish diets with *L. plantarum* probiotics can be beneficial.