

Alternative Sources of Immunoglobulins for Swine from 0-21 Days Post-Weaning

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Introduction

There are a couple of critical periods when piglets are susceptible to intestinal pathogens: 1) first week of life (colostral period); and 2) three weeks of age which typically corresponds with weaning. Due to the unique placental pattern of pigs, there is virtually no transfer of maternal antibodies to the fetus in utero. Therefore, colostrum consumption and absorption is essential for passive transfer of immunity. If passive transfer to the neonatal pig is successful circulating antibodies reach adult levels within 24 hours. However the average half-life of immunoglobulins is about 20 days, and the young pig does not synthesize adult levels of circulating antibodies until 6 months of age therefore, antibody concentrations are lowest around 3 weeks of age (weaning). During this period there exists a window of opportunity for susceptibility to intestinal pathogens. The net result is typically post-weaning diarrhea along with a depression in performance or in severe cases, mortality.

Even though the pre and post weaned animal is no longer able to absorb large immunoglobulin proteins or antibodies directly into the circulation, they still play an essential role in the maintenance of gut health. Some immunoglobulins will bind to the fimbriae of gram negative bacteria, thus preventing adherence and subsequent colonization. Another role for immunoglobulins (specifically G) is agglutination of toxins. The immunoglobulin proteins are able to form a network with many other antibodies and bound toxins, this network becomes so large that the once soluble antigens now precipitate and are no longer small enough to penetrate the epithelial barrier. This is important due to the fact that gut architecture can be severely compromised by bacterial invasion. Any disturbance of the epithelial cells which make up the villi will result in modification of the transport system of the cellular membrane. In addition to scours, this can cause malabsorption, hemorrhaging and acute inflammation.

Nutritionally, researchers have evaluated various feedstuffs and feed additives with the goal of reducing losses associated with post-weaning scours. However, public concern has arisen worldwide with respect to the use of antibiotics in livestock feedstuffs thus, leading to the ban of many of these products in various countries. This has led to the study of alternatives such as natural immunoglobulin sources, which have been shown to improve health and performance of pigs.

Studies with Alternative Immunoglobulin Sources

ProtiOne

ProtiOne is a proprietary product from Trouw Nutrition that takes advantage of various sources of antibodies to develop a total immunoglobulin source. ProtiOne is a combination of Protimax, porcine plasma, serum globulins and albumin. The following details two studies comparing ProtiOne to spray dried porcine plasma (SDPP):

Experiment 1.

Two hundred barrows were weaned at 14 days of age and randomly assigned to one of four dietary treatments: 1) basal diet + 6% SDPP; 2) basal diet + 4% ProtiOne; 3) basal diet + 2% ProtiOne; and 4) basal diet + 2% SDPP. Pigs were allowed ad libitum access to feed and water for the 14 day trial. Data is reported below:

	6% SDPP	4% ProtiOne	2% ProtiOne	2% SDPP
Week 1				
ADG, kg	0.19a	0.18a	0.14b	0.14b
ADFI, kg	0.28	0.26	0.24	0.23
Gain:Feed	0.68	0.71	0.59	0.62
Week 2				
ADG, kg	0.40a	0.38a	0.37a	0.33b
ADFI, kg	0.58	0.56	0.56	0.54
Gain:Feed	0.69a	0.68a	0.66a	0.61b
Week 1-2				
ADG, kg	0.30a	0.28ab	0.26bc	0.24c
ADFI, kg	0.43	0.41	0.40	0.38
Gain:Feed	0.69a	0.68a	0.65b	0.63b

abc Means within rows followed by a different letter differ according to LSD (P<0.05)

Experiment 2.

One hundred and sixty-two hundred barrows and gilts were weaned at 14 days of age and randomly assigned to one of three dietary treatments: 1) basal diet + 6% SDPP; 2) basal diet + 4% ProtiOne; 3) basal diet + 4% SDPP. Pigs were allowed ad libitum access to feed and water for the 14 day trial. Data is reported below:

	6% SDPP	4% SDPP	4% ProtiOne
Week 1			
ADG, kg	0.23	0.21	0.23
ADFI, kg	0.27b	0.29a	0.28ab
Gain:Feed	0.85a	0.73b	0.85a
Week 2			
ADG, kg	0.28ab	0.25b	0.31a
ADFI, kg	0.39	0.35	0.38
Gain:Feed	0.74	0.72	0.82
Weeks 1-2			
ADG, kg	0.26a	0.23ab	0.27a
ADFI, kg	0.33	0.32	0.33
Gain:Feed	0.78ab	0.72b	0.83a
ab Means within rows followed by a different letter differ according to LSD (P<0.05)			

Protimax

Protimax is a patented specialty protein source derived from hyperimmunized hens. Protimax® contains very high titers of specific antibodies for several strains of E. coli, and salmonella as well as many other pathogens. The following studies compare Protimax to plain spray dried egg and or SDPP.

Experiment 1.

Two hundred barrows were weaned at 14 days of age and randomly assigned to one of two dietary treatments: 1) basal diet + 0.1% Protimax; 2) basal diet + 0.1% plain spray dried egg (SDE). Pigs were allowed ad libitum access to feed and water for the entire 14 day trial. Data is reported in the following table:

	0.1% Protimax	0.1% SDE
Week 1		
ADG, kg	0.16a	0.14b
ADFI, kg	0.23	0.24
Gain:Feed	0.69a	0.57b
Week 1		
ADG, kg	0.25	0.25
ADFI, kg	0.36	0.38
Gain:Feed	0.70	0.66
Week 1		
ADG, kg	0.21	0.20
ADFI, kg	0.30	0.31
Gain:Feed	0.69a	0.63b
ab Means within rows followed by different letters differ according to LSD (P<0.05)		

Experiment 2.

One hundred and eighty barrows were weaned at 16 days of age and randomly assigned to one of four treatments. During phase I, all pigs were fed a common starter pellet for 4 days. On day 5 post-weaning, pigs were fed one of four dietary treatments for the subsequent 14 days: 1) basal diet + 2% SDPP; 2) basal diet + 0.1% Protimax + 1.9% SDE; 3) basal diet + 0.15% Protimax + 1.85% SDE; and 4) basal diet + 0.2% Protimax + 1.8% SDE. Pigs were allowed ad libitum access to feed and water for the entire 14 day trial. The overall goal was to evaluate various combinations of Protimax and SDE to SDPP. Data is reported in the following table:

	2% SDPP	0.1% Protimax 1.9% SDE	0.15% Protimax 1.85% SDE	0.2% Protimax 1.8% SDE
Week 1				
ADG, kg	0.23b	0.31a	0.28a	0.30a
ADFI, kg	0.38	0.38	0.37	0.37
Gain:Feed	0.60b	0.81a	0.76a	0.79a
Fecal Score	3.43c	3.03a	3.0a	3.21b
Week 2				
ADG, kg	0.44	0.42	0.45	0.46
ADFI, kg	0.61	0.61	0.65	0.61
Gain:Feed	0.73	0.69	0.69	0.75
Fecal Score	3.0	3.0	3.0	3.0
Weeks 1-2				
ADG, kg	0.34b	0.36ab	0.37a	0.37a
ADFI, kg	0.49	0.49	0.51	0.49
Gain:Feed	0.68b	0.74a	0.72ab	0.76a
Fecal Score**	3.22c	3.02a	3.0a	3.11b
abc Means within rows not followed by a common letter differ according to LSD (P<0.05)				
**1=dry, firm stool; 3=normal; 5=watery diarrhea				

Experiment 3

One hundred and eighty barrows were weaned at 17 days of age and randomly assigned to one of four treatments. During phase I, all pigs were fed a common starter pellet as used in experiment 2. On day 5 post-weaning, pigs were fed one of four dietary treatments for the subsequent 14 days: 1) basal diet + 0% SDPP; 2) basal diet + 3% SDPP; 3) basal diet + 0.1% Protimax + 2.9% SDE; and 4) basal diet + 0.15% Protimax + 2.85% SDE. Pigs were allowed ad libitum access to feed and water for the entire 14 day trial. The overall goal was to follow up experiment 2 and evaluate various combinations of Protimax and SDE to SDPP and to also compare to diets deficient in SDPP. Data is reported in the following table:

	No SDPP	3% SDPP	0.1% Protimax 2.9% SDE	0.15% Protimax 2.85% SDE
Week 1				
ADG, kg	0.08c	0.13b	0.18a	0.19a
ADFI, kg	0.13c	0.18b	0.21a	0.22a
Gain:Feed	0.65b	0.75a	0.83a	0.86a
Fecal Score	3.3b	3.12ab	3.0a	3.07a
Week 2				
ADG, kg	0.22b	0.30a	0.29a	0.29a
ADFI, kg	0.36b	0.47a	0.46a	0.46a
Gain:Feed	0.61	0.63	0.63	0.63
Fecal Score	3.06	3.03	3.02	3.0
Weeks 1-2				
ADG, kg	0.16c	0.21b	0.24ab	0.24a
ADFI, kg	0.25b	0.32a	0.34a	0.34a
Gain:Feed	0.63b	0.66ab	0.70ab	0.71a
Fecal Score**	3.18b	3.08ab	3.01a	3.04a
Mortality, %	4.4	0	0	0
abc Means within rows followed by different letters differ according to LSD (P<0.05)				
**1=dry, firm stool; 3=normal; 5=watery diarrhea				

Experiment 4.

One hundred and sixty barrows were weaned at 17 days of age and randomly assigned to one of four treatments. During phase I, all pigs were fed a common starter pellet for 5 days. On day 6 post-weaning, pigs were fed one of four dietary treatments for the subsequent 14 days: 1) basal diet + 0% SDPP; 2) basal diet + 2% SDPP; 3) basal diet + 0.1% Protimax + 1.9% SDE; and 4) basal diet + 2% SDE. Pigs were allowed ad libitum access to feed and water for the entire 14 day trial. The overall goal was to follow up experiment 2 and 3 and evaluate various combinations of Protimax and SDE to SDPP or SDE and to also compare to diets deficient in SDPP. Data is reported below:

	No SDPP	2% SDPP	0.1% Protimax 1.9% SDE	2% SDE
Week 1				
ADG, kg	0.20b	0.25a	0.25a	0.24a
ADFI, kg	0.28b	0.34a	0.33a	0.34a
Gain:Feed	0.71	0.72	0.75	0.69
Week 2				
ADG, kg	0.31bc	0.37a	0.33ab	0.28c
ADFI, kg	0.48b	0.52a	0.49ab	0.46b
Gain:Feed	0.63	0.70	0.68	0.60
Week 1-2				
ADG, kg	0.25c	0.31a	0.29ab	0.26bc
ADFI, kg	0.38b	0.43a	0.41a	0.40ab
Gain:Feed	0.66	0.74	0.70	0.65
Mortality, %	5	0	0	0
abc Means within rows not followed by a common letter differ according to LSD (P<0.05)				

Conclusion

A majority of the problems associated with weanling pigs occurs following periods of low voluntary feed intake. Depressed feed intake can impair gut architecture and function. Additionally, depressed feed intake often occurs simultaneously with low circulating immunoglobulins and can create devastating affects. Numerous dietary strategies have been devised to avoid these problems. Plasma protein is considered one of the best and most consistent ingredients for maintenance of adequate feed consumption post-weaning. Recently, several alternative immunoglobulin sources have become available in order to offer options to plasma protein. However, most of these alternative products have not shown a consistent improvement over plasma itself during the first week or two post-weaning. ProtiOne has demonstrated significant improvements over plasma during the first two weeks post-weaning. Additionally, studies have shown that one third less ProtiOne can be used to achieve a similar response to plasma. ProtiOne is designed to provide a consistent array of natural globulin proteins targeted to the challenges of the weanling pig. In addition to Ig derived from porcine sources, ProtiOne contains Protimax which contains antibodies produced from hens that are selectively immunized to provide specialized proteins specific for the pig. Protimax egg protein has been found to be equal to plasma protein in maintenance of food intake and may be considered an adequate substitute especially in diets beyond the first few days post-weaning. This could be a viable alternative where replacement products have been needed due to scrutiny of most animal proteins.