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An Evaluation of Nutrition Strategies to Lower Pig Starter Feed Costs

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Abstract

Four hundred-ten pigs (weaning wt. = 12.1 lb.) were used in four experiments to evaluate the impact of four progressively lower cost pig starter formulations on pig performance during an initial 7-14 day transition, and for an overall 28-post-weaning feeding period. The four experimental preparations: **Diet 1)** 22% dried whey (DW), 7.5% lactose (L) , and 6% spray dried animal plasma (SDAP), **Diet 2)** 22% DW, 7.5% L, 2%SDAP, 2% soy protein concentrate (SPC), and 2% spray dried blood meal (SDBM), **Diet 3)** 29% DW and 4.5% SDAP, **Diet 4)** 29% DW, 1.5% SDAP, 2% SPC, and 1% SDBM were fed in corn-, hull-less waxy barley-, hull-less oats- and HRS wheat-based diets in separate experiments and compared to a corn control diet containing 22% DW, 7.5% L and 6% SDAP. Formulations containing either 4.5 or 6% SDAP minimized weaning lag during the initial 0-14 day period following weaning when corn and hull-less waxy barley served as the grain bases. However, compensating growth during the 14-28 day period by pigs fed the lowest cost diet 4 resulted in overall feed cost savings of 15.5 and 10.6% respectively, for corn and hull-less waxy barley fed pigs. When the experimental formulations were fed with either hull-less oats or HRS wheat the stimulating effect of SDAP on ADG and feed intake were not observed. In the presence of hull-less oats and HRS wheat, early-weaning pig growth without weaning lag was recorded with all of the test formulations. Over the 28-day feeding period, and compared to the corn control diet, feeding the lowest cost Diet 4 lowered feed costs 5.8 and 17.6% respectively, for pigs fed HRS wheat and hull-less oats.

Introduction

When baby pigs are weaned between 14 and 21 days of age nutrient-dense pig starter feed must be provided to insure steady and economical growth without weaning lag. Within the first four weeks after a 21 day weaning, a healthy pig will customarily consume from 27 to 32 pounds of feed and grow an average .7 pound per day. This growth is derived from gains ranging from .30 pound/day during the first week after weaning to gains of 1.10 pounds/day by the end of a four week post-weaning period. Pigs weaned averaging 10 to 13 pounds that grow according to their full genetic potential will nearly triple their weight, weighing 29 - 33 pounds in four weeks, while consuming 1.6

pounds of nutrient-dense feed/pound of gain. Feed consumption during the first 28-days after weaning represents approximately 5% of the feed required to grow a pig from weaning to 250 pounds. While the young, healthy, pig is a very efficient converter of nutrients to body tissue, dietary ingredients required to insure pigs will grow to their full genetic potential are expensive. Exercising a plan for the strategic allocation of nutrient dense ingredients may provide a way to lower pig starter feed cost without compromising weanling pig growth.

Highly digestible feedstuffs such as spray-dried animal plasma (SDAP), soy protein concentrate (SPC), spray-dried blood meal (SDBM), purified lactose (L) and dried whey (DW)] are valuable ingredients in pig starter diets. When supplied in proper proportions they stimulate feed intake, daily gain and minimize post-weaning lag (Stoner et al., 1990, Hansen et al., 1993, Kats et al., 1994 and de Rodas et al., 1995). The first objective of this nutrition management investigation was to evaluate nutrient replacement strategies to determine if feed intake and pig growth could be maintained while lowering the cost of production. The second objective was to evaluate pig response and efficacy when the experimental protein and lactose formulations were prepared with either corn, hull-less oats, hull-less waxy barley or spring wheat as basal grains.

Materials and Methods

Four experiments were conducted using four hundred-ten pigs in which corn, hull-less waxy barley, hull-less oats, or HRS wheat were used as grain-bases. A corn-based control diet containing 22% dried whey (DW), 7.5% lactose (L) and 6% spray-dried animal plasma (SDAP), was compared to the following progressively less expensive phase-1 diets: **Diet 1)** 22% DW, 7.5% L , and 6% SDAP, **Diet 2)** 22% DW, 7.5% L, 2%SDAP, 2% SPC, and 2% SDBM, **Diet 3)** 29% DW and 4.5% SDAP, **Diet 4)** 29% DW, 1.5% SDAP, 2% SPC, and 1% SDBM. Weaning transition test diets fed during Phase-1 (0-7days post-weaning), were reduced significantly in Phase-2 (7-14 days post-weaning) diets, and were removed entirely in a common Phase-3 diet that was fed across all treatment groups during days 14-28 post-weaning. The total feeding period was 28 days. In addition to the lactose and protein test ingredients, all phase-1 diets contained 10% menhaden fish meal and 13% soybean meal. Pig starter diets with each of the grain bases were prepared according to the dietary specifications shown in Table 1 for Phases 1, 2 and 3. Diet cost per ton for each of the three phases and grain bases are shown in Table 2.

Pigs in the study were weaned at 21 days of age, vaccinated with a 3-way multivalent vaccine (A. pleuropneumoniae, H. parasuis and erysipelas) and randomly allotted to four replicates per dietary treatment. Pigs and feed were weighed on 7d, 14d, 21d, and 28d after weaning. Weekly pig performance is shown Tables 3,4,5 and 6 for the test ingredients fed in corn, hull-less waxy barley, hull-less oat, or HRS wheat grain-bases.

Results and Discussion

Corn-Base Pig Starter (Experiment 1, Table 3)

Phase 1 (Transition Diet 0-7 Days)

Pigs with an average starting weight of 13.1 pounds were fed the progressively lower cost transition test diets during week one after weaning. Numerical differences were observed for ADG, but were not different statistically. Total feed consumption and ADFI were greater (P=.03) when either 4.5 or 6% animal plasma was fed in the corn-based starter. Pig gains paralleled feed intake which was numerically higher for pigs that received 4.5 and 6% animal plasma, however, differences in gain between feeding animal plasma alone versus feeding the tested protein combinations (Diets 2 and 4) did not differ. Feed efficiency (G:F) was greatest (P=.07) when lactose was included in the diet.

Phase 2 (Transition Diet 7-14 Days)

Phase-2 gain and ADG were consistent with growth observed in the first phase and was greatest for those pigs receiving Diets 1 and 3 which were formulated with either 4.5 or 6% animal plasma. Feed intake, G:F, and feed cost/pound of gain differed numerically, however, the differences observed were not significant.

Phase 3 (Common Diet 14-28 Days)

Subsequent pig performance following weaning transition diets fed in Phases 1 and 2 differed numerically among the criteria measured but the differences were not significant. Pigs fed Diet 4, formulated to be the lowest cost transition starter diet, yielded the most favorable feed efficiency (P=.05) and feed cost/pound of gain (P=.06) during the 3rd week post-weaning. While gain in the third phase for pigs fed Diet 4 did not differ from the other test diets, pig growth with Diet 4 lagged behind the other test treatments during the first two weeks post-weaning and then grew numerically faster during the last two weeks when the phase-3 diet was fed, suggesting growth and feed efficiency of a compensating nature.

Combined 28-Day Performance

Pigs receiving a corn-based diet and either 4.5 or 6% plasma consumed more during the Phase-1 transition after weaning and for the 28-day period. No measurable difference in pig performance due to lactose source were recorded, however, feed cost/pound of gain was lower when lactose was derived from dried whey. Pigs receiving transition test Diet 4 (29% dried whey, 1.5% animal plasma, 2% soy protein concentrate, and 1% blood meal) had similar feed consumption and gain efficiency when compared to Diets 1 and 3 that contained the highest levels of animal plasma, but Diet 4 was less expensive to feed (P=.07). Although, 28-day feed cost among pigs fed Diet 4 was 15.5% less, Diet 4 pigs were also 1.5 pounds lighter.

Based on pig performance resulting from test ingredient comparisons in this corn-based experiment, Diet 1 (22% dried whey, 7.5% lactose, and 6% SD animal plasma) was selected to serve as the corn-based control diet for the hull-less waxy barley-, hull-less oat-, and HR spring wheat-based pig starter experiments.

Hull-less Waxy Barley-Base Pig Starter (Experiment 2, Table 4)

Phase-1 (Transition Diet 0-7 Days)

The average starting weight for pigs fed in this second experiment was 11.7 pounds. No differences were measured when the corn control diet was compared to all diets containing hull-less waxy barley. Differences were observed, however, based on protein and lactose sources within the hull-less waxy barley-based diets. Average daily gain (P=.06) and ADFI (P=.01)were greatest when Diet 3 was fed that contained 4.5% SD animal plasma and lactose derived solely from dried whey. Diets that contained dried whey only were also associated with a lower cost/pound of gain.

Phase-2 (Transition Diet 7-14 Days)

During the second week after weaning, differences between diets were minimal, however, test diets containing SD animal plasma (Diet 1 and 3)had a higher gain to feed ratios (P=.03), but differences in feed cost/pound of gain did not differ.

Phase-3 (Common Diet 14-28 Days)

Pigs receiving the lower cost pig starter formulations in Diets 2 and 4 lagged behind the other treatments during Phases 1 and 2, and then grew numerically faster during weeks 3 and 4 of the 28-day feeding study. This growth recovery response was similar to that observed in the first experiment and is a typical growth response of pigs that start on feed slowly following weaning. As a result of the recovery type growth observed, especially during the 3rd week after weaning, pigs receiving hull-less waxy barley diets grew faster, were more feed (P=.05) and cost (P=.05) efficient than pigs fed the control diet. By the 4th week, stability with respect to pig growth and efficiency was evident among all treatments.

Combined 28-Day Period

For the 28-day feeding period, pigs fed the hull-less waxy barley-base performed equally with pigs receiving the corn control diet. Pigs that received the lowest cost transition Diet 4 (29% dried whey, 1.5% SD animal plasma, 2% soy protein concentrate, and 1% blood meal) lagged behind the other treatments during Phases 1 and 2. Compensating growth among pigs receiving Diet 4 resulted in overall comparable performance across treatments and the lowest cost/pound of gain (P=.003). Feeding the cost reducing protein and dried whey formulation fed in Diet 4 reduced 28-day feed cost by 10.6% when compared to the corn-based control diet.

Hull-less Oat-Base Pig Starter

(Experiment 3, Table 5)

Phase-1 (Transition Diet 0-7 Days)

In the presence of hull-less oats, pigs with an average weaning weight of 11.6 pounds grew similarly regardless of test diet protein or lactose source. There was a numerical trend toward slower growth among pigs fed the corn control diet, however, the difference was not significant. Feed cost/pound of gain favored the hull-less oat-based diets (P=.03). An interaction was measured such that in the presence of hull-less oats pigs fed cost reducing diets 2 and 3 positively influenced total feed intake (P=.03) and ADFI (P=.02).

Phase-2 (Transition Diet 7-14 Days)

In the second week, control pigs that lagged behind pigs receiving naked oats during the first week post-weaning compensated for their slower start and gained faster (P=.04) than pigs receiving naked oat test diets.

Phase-3 (Common Diet 14-28 Days)

Growth and G:F efficiency was similar across treatments during the third week post-weaning. Growth during the fourth week was greater (P=.08) among Diets 3 and 4 that were formulated with 29% dried whey as compared to the other treatments formulated with 22% dried whey and 7.5% lactose during the transition phases.

Combined 28-Day Performance

Pig response to cost lowering protein and lactose treatments during the 28-day post weaning period did not differ with respect to gain and feed intake. Gain to feed efficiency was improved (P=.08) when the dietary lactose source was derived solely from dried whey. Diets 3 and 4, formulated with dried whey as the sole source of lactose, were the most economical diets to feed. Feeding the lowest cost Diet 4, over the 28-day post-weaning period, lowered feed cost 17.6% compared to the control diet.

Hard Red Spring Wheat-Base Pig Starter (Experiment 4, Table 6)

Phase-1 (Transition Diet 0-7 Days)

Weanling pigs with an average weaning weight of 11.9 pounds that received wheat-based formulations consumed more feed during the first week post-weaning (P=.01). Numerical differences were observed for many of the parameters measured with respect to protein and lactose sources but mean differences were not significant. Pig growth without any signs of weaning lag was observed across all treatments during the Phase-1 transition period.

Phase-2 (Transition Diet 7-14 Days)

Steady and consistent growth documented in Phase-1 continued into the second week of the study. All treatments supported similar growth and performance suggesting HRS wheat, in the presence of all of the protein and lactose sources tested, effectively minimizes weaning lag.

Phase-3 (Common Diet 14-28 Days)

In the third week, pigs receiving protein combinations in Diets 2 and 4 consumed more feed (P=.08) than those treatments receiving spray-dried animal plasma in Diets 1 and 3. When corn-fed control pigs were compared to all of the wheat-based experimental diets, they grew numerically faster and consumed significantly more feed (P=.01). During the fourth week, pigs that had received dried whey as the sole source of lactose after weaning and those that received the cost reducing protein combinations in Diet 4 gained at the fastest rate and were the most gain efficient (P=.07).

Combined 28-Day Performance

Over the 28-day post-weaning period pigs that had received the lowest cost wheat-based transition Diet 4 consumed more feed, (P=.01), grew at the fastest rate (P=.01), and had the lowest feed cost/pound of gain (P=.07) when compared to the other transition diet treatments. Feeding wheat-based transition Diet 4 resulted in a 5.8% feed savings and pigs that were 2.3 pounds heavier (P=.01) than pig fed the corn-based control diet.

Discussion

Nutrient-dense diets for early weaned pigs must promote feed intake in the transitional young pig and provide highly digestible amino acids in proper balance. Spray-dried animal plasma has been shown by Gatnau and Zimmerman (1990, 1992), Sohn et al. (1991), and Kats et al. (1994) to be an effective, highly digestible, source of amino acids for weanling pigs. Its presence in the transition diet has been shown by Hansen et al. (1993) and de Rodas et al. (1995) to stimulate feed intake and subsequent ADG during the first 7-14 days post-weaning. Bergstrom (1997) further evaluated spray-dried animal plasma in the diets of pigs weaned at 12 - 14 days of age documenting that high health status SEW pigs responded less to the presence of spray-dried animal plasma in the transition diet than pigs of lower health status.

Pigs in the present study were weaned into an All In/All Out nursery facility that was separated from the farrowing facility but located on the same farmstead. Considering pig response to the experimental transition diets fed with the four different feed grains, including either 4.5 or 6% spray-dried animal plasma stimulated feed intake and ADG when corn and hull-less waxy barley were the basal grains. However, when hull-less oats and HRS wheat were the basal feed grains, the presence of either 4.5 or 6% spray-dried animal plasma did not stimulate feed intake and ADG more than the other less expensive protein combinations and lactose sources formulated into Diets 2 and 4. Based on the pig response in the four experiments conducted, formulations that derived lactose solely from dried whey as compared to a combination of dried whey and purified lactose contributed to improved performance and less expense.

Results of these experiments agree with the findings of other research with respect to corn as the basal feed grain when fed in conjunction with spray-dried animal plasma, dried whey and lactose. However, when higher quality wheat and hull-less oat feed grains are the basal grains in early-weaning transition diets, the magnitude of response from spray-dried animal plasma is diminished and lower cost

ingredients can be cost effectively utilized.

Implications

Results of these experiments suggest that lower cost nutrient-dense, high performance, transition pig starter diets can be effectively prepared using reduced levels of spray-dried animal plasma, soy protein concentrate, spray-dried blood meal, and dried whey when high energy hull-less oats and HRS wheat are selected as basal grains. Which nutrient-dense ingredients to use in pig starter formulations will be based largely on availability and current economics.

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Report Tables

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Table 1. Experimental Diet Nutrient Specifications For Each Phase.

Table 2. Diet Cost/Ton When Experimental Diets Were Prepared With Each Grain Base.

Table 3. Corn-Base 28-Day Pig Starter Performance.

Table 4. Hull-less Waxy Barley-Base 28-Day Pig Starter Performance.

Table 5. Hull-less Oat-Base 28-Day Pig Starter Performance.

Table 6. HRS Wheat-Base 28-Day Pig Starter Performance.

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