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The effects of various feed additives on growth performance of nursery pigs

Jennifer Tucker
Louisiana State University and Agricultural and Mechanical College

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THE EFFECTS OF VARIOUS FEED ADDITIVES ON GROWTH
PERFORMANCE OF NURSERY PIGS

A Thesis
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The Interdepartmental Program in
Animal and Dairy Sciences

Jennifer Tucker
B.S., Southern Arkansas University, 2004
May 2007
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ABSTRACT

The objective of this research was to evaluate the effects of various feed additives on growth performance of nursery pigs. An experiment was conducted in which pigs were fed a conventional Phase 1 diet containing: 1) no salmon protein hydrolysate (SPH) or spray-dried porcine plasma (SDPP); 2-3) 1.5% SPH or SDPP; 4-5) 3.0% SPH or SDPP; or 6) 1.5% SPH and 1.5% SDPP. The results of this experiment showed growth performance was unaffected by source or level of protein during any growth phase. Overall gain:feed was greater (P = 0.08) for pigs fed the 1.5% level of protein than for those fed 3.0%, but there was no difference between protein sources. A second experiment was conducted in which pigs were fed a conventional Phase 1 diet (no mammalian protein) containing: 1) no SPH or SDPP; 2-3) 1.5% SPH or SDPP; or 4) 1.5% SPH and 1.5% SDPP. All pigs were fed common Phase 2 and 3 diets. The results of this experiment showed during Phase 1, gain:feed was greater (P < 0.05) for pigs fed SDPP than for those fed SPH. During Phase 2, ADFI was greater (P < 0.05) for pigs fed SPH than for those fed the control. During Phase 3, gain was greater (P = 0.08) for pigs fed SDPP than for those fed SPH. Overall growth performance was unaffected by protein source. An experiment was conducted in which pigs were fed Phase 1, 2, and 3 diets containing: 1) control; 2-5) 10.0% Nutri-Sure (NS), ground oat groats (GOG), ground steam rolled oats (SRO), or feeding oat meal (FOM). The results of this experiment showed during Phase 1, growth performance was unaffected by diet. During Phase 2, feed intake was greater (P < 0.09) for pigs fed GOG or SRO than for those fed NS. During Phase 3, feed intake was greater (P < 0.05) for pigs fed FOM than for those fed the control. Overall gain:feed was greater (P < 0.03) for pigs fed NS or SRO than for those
fed the control. The results of these experiments indicate that SPH, SDPP, NS, GOG, SRO, and FOM are adequate additions to nursery diets.
CHAPTER 1

INTRODUCTION

Various feed ingredients are added to diets for nursery pigs to more closely meet their needs at this critical time in life. New feed ingredients are continually being evaluated for nursery pigs.

During the days after weaning, the pig’s small intestinal structure changes. These changes decrease the digestive and absorptive abilities that may, to a degree, be responsible for a reduced potential for in performance (Pluske et al., 1997). These changes result in a need for highly digestible proteins. Many nursery diets contain large quantities of milk products that make the nursery diets more closely related to sow’s milk.

Soybean meal is known to have many anti-nutritional factors that cause morphological changes in the small intestine (Liener, 2000). These changes decrease nutrient uptake that subsequently decrease growth (Pluske et al., 1997).

In the past few decades, there has been an effort to conserve our resources and to reduce environmental contamination. The animal feed industry has adopted this concept. Many of the common products fed to animals today are derived from the waste of other manufactured products. For example, spray-dried plasma protein (SDPP) is a by-product from the meat packing industry (Coffey and Cromwell, 2001) and whey is made from co-products of manufacturing cheese. Nutri-Sure is a by-product of cereal manufacturing.

The purpose of this research is to evaluate different co-products as a partial replacement for soybean meal and SDPP in diets for nursery pigs; and to evaluate a by-product of cereal manufacturing to replace oats in these diets.
CHAPTER 2
REVIEW OF LITERATURE

New feed additives are constantly being evaluated to measure their ability to improve nursery pig performance. Many of the available products are used as partial replacements of corn, the main energy source, or soybean meal, the main protein source. By replacing a minimal amount of either corn or soybean meal with an additive that more closely meets the needs of the nursery pig, animal performance may be improved.

SPRAY-DRIED PLASMA PROTEIN AND SALMON PROTEIN HYDROLYSATE

Many protein sources present in nursery pig diets have been studied. The one commonly included in nursery pig diets, usually fed during the first week or 2 wk post weaning, is SDPP. Spray-dried plasma protein has been shown to have a positive effect on ADG, ADFI, and G:F; however, the extent of the effect and the percent that must be added to the diet is still of some debate. Regardless of this, it is still used to measure the ability of other protein sources fed at the same level.

Effect of Spray-Dried Plasma Protein on Growth Characteristics

The effects of SDPP were first reported in 1987 when Zimmerman fed 10% SDPP for 26 d during the starter phase. He reported that pigs fed SDPP had a higher overall ADG and overall ADFI but saw no improvement in overall G:F. In 1990, Gatnau and Zimmerman conducted an experiment comparing 10% SDPP to 10% casein, meat extract, or isolated soy protein fed for 28 d post weaning. For d 0 to 14, pigs fed SDPP tended to have an increased ADG and ADFI when compared to the other three diets. Overall, pigs fed SDPP had an increased ADG when compared to meat extract, an increased ADFI when
compared to meat extract and isolated soy protein, and a decreased G:F when compared to isolated soy protein and casein. Gatnau and Zimmerman (1991) also compared SDPP to a control diet, the control diet with 5% SDPP and 3.8% blood meal, and the control diet with 7.5% blood meal. The experimental diets were fed for the first 2 wk post weaning. During d 0 to 14, pigs fed SDPP had an increased ADG compared with pigs fed the control or the control with blood meal, an increased ADFI compared to the other three diets, and an increased G:F compared with pigs fed the control diet with blood meal. Overall, pigs fed SDPP had an increased ADFI compared with pigs fed the control diet. Gatnau et al. (1991) reported a linear increase in ADG, ADFI, and G:F for d 0 to 14 when feeding 0, 2, 4, 6, or 8% SDPP for the first 2 wk post weaning, reported no significant differences for overall ADG and overall G:F, but reported a quadratic increase for overall ADFI. Gatnau and Zimmerman (1992) also studied the optimum level of SDPP to be included in nursery pig diets by feeding 0, 2, 4, 6, 8, or 10% SDPP for the first 14 d post weaning. They reported a linear and quadratic increase for ADG and ADFI for the first 14 d as well as a linear increase for G:F. Overall, a quadratic increase for ADG and ADFI was reported as well as a linear increase for G:F. Also in 1992, Richert et al. compared SDPP to dried skim milk (DSM), whey protein concentrate (WPC), and dried buttermilk (DBM). The experimental diets were fed for the first 14 d post weaning. For d 0 to 14, pigs fed SDPP had an increased ADG and ADFI compared to WPC and DBM. For d 0 to 14, pigs fed SDPP had a decreased G:F compared to DSM, WPC, and DBM. For d 14 to 28, pigs fed SDPP had a decreased G:F compared to pigs fed WPC or DBM. Overall, pigs fed SDPP had the highest ADFI, but they had a decreased G:F compared to pigs fed WPC or DBM. Hansen et al. (1993)
reported that ADG and ADFI increased during d 0 to 7 when 10% SDPP was fed for the first 14 d post weaning, but they reported no significant differences overall. In two follow-up experiments, Hansen et al. (1993) fed either 10.35% SDPP with 20% dried whey or 13.40% SDPP with no whey in the first experiment and fed 10.28% SDPP with no DSM in the second experiment for 14 d post weaning. They reported an increased ADG and ADFI for d 0 to 14. Kats et al. (1994) reported a linear increase in ADG and ADFI when 0, 2, 4, 6, 8, or 10% SDPP were fed for 14 d post weaning. Kats et al. (1994) also reported an overall linear increase in ADG and ADFI. Ratanen et al. (1994) reported a linear increase for ADG and ADFI when feeding 0, 2, 4, or 6% SDPP for 0 to 14 d post weaning. Pendergraft et al. (1994) fed SDPP and wheat gluten for the first 14 d post weaning. For d 0 to 14, pigs fed SDPP had an increased ADG and ADFI; however, for d 14 to 21, pigs fed wheat gluten had a higher ADG and ADFI. Overall, there were no significant differences. Coffey and Cromwell (1995) reported no significant differences for ADG and ADFI when feeding 0, 3, 6, 9, and 12% SDPP for d 0 to 14 post weaning, but for feed:gain a quadratic increase was reported with increasing levels of SDPP for d 0 to 14. Smith et al. (1995) fed 5% SDPP for 0 to 14 d post weaning and reported greater ADG for 0 to 14 d as well as 0 to 28 d and greater G:F for 0 to 14 d. Pierce et al. (1996) conducted two experiments feeding 8% SDPP, 8% spray-dried bovine plasma, or a globulin-rich fraction of bovine plasma at 50% or 100% of the globulin of the diet with 8% spray-dried bovine plasma for the first 14 d post weaning. In both experiments, SDPP increased ADG and ADFI. Also in 1996, Lindemann et al. fed 3% or 6% enzymatically digested protein or SDPP for two 28 d experiments. A positive linear effect was reported for ADG, ADFI, and feed:gain for both protein sources.
In 1997, Nessmith et al. conducted two experiments, both in a 3 x 2 x 2 factorial, with lactose (0, 20, or 40%), SBM (0 or 20%), and SDPP (0 or 7% in Exp. 1 and 7.5% in Exp. 2). The experimental diets were fed from d 0 to 14 post weaning in Exp. 1 and d 0 to 10 post weaning in Exp. 2. In Exp. 1, pigs fed diets containing SDPP had increased ADG and ADFI for 0 to 7 d. The same was reported for d 0 to 14, but a decrease in G:F also was reported. For d 14 to 34, pigs previously fed SDPP had no differences in ADG or ADFI, but had a decreased G:F. In Exp. 2, for d 0 to 5, SDPP increased ADG but did not affect ADFI or G:F. For d 0 to 10, pigs fed SDPP had increased ADFI, but ADG and G:F were not affected. For d 10 to 26, pigs previously fed SDPP had no change in ADG, ADFI, or G:F.

Koehler et al. (1998) fed 4% SDPP for d 0 to 14 post weaning and reported an increased ADG and ADFI for d 0 to 14 as well as overall when compared to the control diet. Lindemann (1998) fed 0, 3, or 6% SDPP for 28 d after a 1 wk post weaning adjustment period. For the 28 d period, a quadratic response was reported for ADG as well as a linear decrease in feed:gain with increasing levels of SDPP. Angulo and Cubiló (1998) fed three diets consisting of 6% SDPP, 6% SDPP and 5% modified soyprotein, and 10% modified soyprotein for 0 to 14 d post weaning and a common diet until d 40. Pigs fed diets with SDPP had increased ADG and ADFI for d 0 to 14. Overall (d 0 to 40), pigs fed diets with SDPP had improved ADG, ADFI, and feed:gain. Guzik et al. (2002) fed 1.5% SDPP for 8 d during Phase 2 (7 to 21 d post weaning) and reported a decrease in ADG, ADFI, and G:F. These findings contradicted previous work conducted in other laboratories. Also in 2002, van Dijk et al. fed 3.0% SDPP and reported no significant differences in ADG, ADFI, and feed conversion ratio for d 1 to 7 but reported an increase in ADG for d 8 to 21 and for d 1 to 21. Pigs fed SDPP also
had a decrease in feed conversion ratio for d 8 to 21 and d 1 to 21. In 2005, Pierce et al. conducted five trials feeding 8.0% SDPP for 14 d, 21 d, or 28 d post weaning. All trials lasted 28 d except one that ended at d 21. Four of the trials reported an increase in ADG and ADFI for d 0 to 7. Two trials reported that pigs fed SDPP had improved feed:gain for 0 to 7 d. Four trials reported an increase in ADFI for 0 to 14 d. One trial reported an increase in ADG for d 0 to 28.

Spray-Dried Plasma Protein Compared to Fish Products

Few experiments have been conducted comparing SDPP to other fish by-products. In 1994, Veum and Halley compared a condensed fish protein digest as a partial replacement for SDPP during the first 7 d post weaning. Their diets were a control diet, 10.0% SDPP, 7.5% SDPP and 2.5% fish protein digest, 5.0% SDPP and 2.5% fish protein digest, or 2.5% SDPP and 7.5% fish protein digest. They reported no significant differences in growth performance for any of the five treatments. Richert et al. (1995) fed Norse LT-94 (herring meal) as a partial replacement for SDPP during the first 14 d post weaning. Their diets were 8, 6, 4, 2, or 0% SDPP with 0, 2.14, 4.29, 6.43, or 8.58% Norse LT-94. A significant linear decrease was reported in ADG and G:F with increasing levels of Norse LT-94 for d 0 to 14 post weaning and overall.

OAT PRODUCTS

Corn is typically fed as the main energy source in nursery pig diets. However, low dietary concentrations of oats products have been shown to have positive effects. Many oat products are on the market including whole oat groats, steam rolled oats, oat flour, and feeding oat meal. Nutri-Sure (NS), a by-product of cereal manufacturing is also available.
Effects of Oat Products on Growth Characteristics

Mahan and Newton (1993) fed 37.65% oat groats for 14 d post weaning. They reported an increase in ADFI and G:F for d 0 to 14. Rantanen et al. (1995) conducted two 38-d experiments that provided much information about several oat products. In Experiment 1, whole oats, ground oat groats, or oat flour were used to replace part of the corn for 0 to 24 d post weaning. For 0 to 24 d, pigs fed whole oats had an increased ADFI and a decreased G:F compared with pigs fed ground oat groats or oat flour. Also for 0 to 24 d, pigs fed oat flour had increased ADG and G:F compared to pigs fed ground oat groats. The same was observed in the overall data except there was no difference for ADG of pigs fed oat flour compared to pigs fed ground oat groats. In Experiment 2, whole oats, roasted oats, ground oat groats, steam flaked oat groats, or oat flour were used to replace part of the corn for 0 to 24 d post weaning. For d 0 to 24, pigs fed whole oats and roasted oats had a decreased ADG and G:F compared with pigs fed oat groats or oat flour, but pigs fed whole oats had a greater ADG than pigs fed roasted oats. Also for d 0 to 24, pigs fed steam flaked oats had a higher ADG compared with pigs fed roasted oats. Overall, pigs fed dehulled oats had a higher G:F compared to pigs fed whole and roasted oats. Kerr et al. (1998) fed 36.5% oat flour for 14 d post weaning and reported no effect on performance. Cromwell et al. (1999) fed 10% steam rolled oats or 10% Nutri-Sure (cereal manufacturing by-product). During d 0 to 7 of the trial no significant differences were reported; however, pigs fed Nutri-Sure had greater overall ADG and ADFI, but feed:gain was not affected. Guzik et al. (2002) fed 8.43% oatmeal for the first 8 d of Phase 2 (d 7 to 21 post weaning) and reported a decrease in ADG and
ADFI, but no significant difference for G:F. van Heugten et al. (2003) fed 22.7% oat flour combined with 5.0% steam rolled oats for the first 14 d post weaning. During this 14 d period, no significant differences were reported; however, at the end of the 42 d study there was an overall decrease in ADG for pigs fed oat flour and steam rolled oats compared with pigs fed the control diet.

CONCLUSION

Both SDPP and oat products are excellent additions to nursery pig diets. The use of fish by-products is still being investigated. Also, one experiment suggests that SDPP may be replaced with a fish by-product and provide the same growth performance. The oat-product studies suggest that almost any oat product can be used successfully. More research needs to be conducted to determine the percentage fish and oat products to be fed in the diet to have the most optimum growth characteristics.
CHAPTER 3

THE EFFECTS OF SALMON PROTEIN HYDROLYSATE AND SPRAY-DRIED PLASMA PROTEIN ON GROWTH PERFORMANCE OF NURSERY PIGS

INTRODUCTION

Spray-dried plasma protein is commonly used as a protein source in nursery pig diets. It has been shown to improve ADG, ADFI, and G:F (Coffey and Cromwell, 2001; van Dijk et al., 2001). Spray-dried plasma protein is expensive and researchers are trying to find a protein source that can be used as an alternative (Kim et al., 2000).

Many fish products and by-products contain high concentrations of easily digestible proteins. Sathivel et al. (2004) reported that approximately half of the by-products from the Arrowtooth flounder, found in the Alaskan waters, are not used. These by-products include the head, frames, and viscera (Sathivel et al., 2005). It has been shown that Alaskan fish are a high quality protein source (Sathivel et al., 2004; Bechtel and Johnson, 2004).

One way to process fish by-products is through hydrolysis. Fish hydrolysates aid in the use of the entire fish carcass. Fish hydrolysates are made from enzymatic hydrolysis of fish processing by-products (Hardy, 2000). The use of fish hydrolysates in feed is not only being investigated in swine nutrition, but also in the pet food industry (Folador et al., 2006).

Salmon protein hydrolysate (SPH) is a high quality protein source made from the heads, frames, and viscera of Atlantic salmon and Rainbow trout through a continuous line process with enzymatic hydrolysis. Salmon protein hydrolysate consists of free AA, peptides, and proteins.
The objective of this study was to evaluate the effects of SPH and SDPP on growth performance of nursery pigs.

MATERIALS AND METHODS

General

The Louisiana State University (LSU) Agricultural Center Animal Care and Use Committee approved all methods used in these experiments. Purebred (Yorkshire) or crossbred (Yorkshire x Landrace or Yorkshire x Duroc) nursery pigs from the LSU Agricultural Center Swine Unit were used. Pigs were housed in a thermally controlled enclosed nursery containing 34 pens with hard plastic slotted floors and an under floor flush system for waste removal. Pigs were offered feed and water ad libitum in a 0.97- x 1.47-m pen. Pigs were allotted to treatment on the basis of ancestry, weight, and sex (as much as possible, there was an equal number of barrows and gilts within each pen). Pigs and feeders were monitored twice daily.

Three batches of SPH were used in these experiments. Each batch was analyzed for AA content. Amino acids were determined after acid hydrolysis (AOAC, 2000; Method 982.30 E(a)). Total sulfur AA content was determined after performic acid oxidation followed by acid hydrolysis (AOAC, 2000; Method 982.30 E(b)). Tryptophan content was determined after alkaline hydrolysis (AOAC, 2000; Method 982.30 E(c)). Amino acid digestibility was determined on the first batch of SPH by the cecetomized rooster assay (Parsons, 1985). The AA content of each batch of SPH and the digestibility coefficients are presented in Table 1.

The diets used in these experiments were formulated on the analyzed AA content for the SPH, on information provided by American Protein Corporation.
Table 1. Amino acid and digestibility profile of salmon protein hydrolysate (SPH)

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Apparent digestibility coefficient, %&lt;sup&gt;1&lt;/sup&gt;</th>
<th>True digestibility coefficient, %&lt;sup&gt;1&lt;/sup&gt;</th>
<th>SPH batch 1</th>
<th>SPH batch 2</th>
<th>SPH batch 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thr</td>
<td>92</td>
<td>98</td>
<td>2.80</td>
<td>2.78</td>
<td>2.96</td>
</tr>
<tr>
<td>Ser</td>
<td>92</td>
<td>97</td>
<td>3.01</td>
<td>2.74</td>
<td>3.07</td>
</tr>
<tr>
<td>Gly</td>
<td>87</td>
<td>92</td>
<td>11.26</td>
<td>10.67</td>
<td>10.20</td>
</tr>
<tr>
<td>Ala</td>
<td>96</td>
<td>98</td>
<td>5.91</td>
<td>6.19</td>
<td>5.66</td>
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<tr>
<td>Cys</td>
<td>73</td>
<td>93</td>
<td>0.49</td>
<td>0.43</td>
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</tr>
<tr>
<td>Val</td>
<td>93</td>
<td>97</td>
<td>2.88</td>
<td>2.92</td>
<td>2.92</td>
</tr>
<tr>
<td>Met</td>
<td>96</td>
<td>98</td>
<td>1.92</td>
<td>1.91</td>
<td>1.99</td>
</tr>
<tr>
<td>Ile</td>
<td>93</td>
<td>97</td>
<td>2.10</td>
<td>2.16</td>
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<tr>
<td>Leu</td>
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<td>97</td>
<td>4.19</td>
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<tr>
<td>Tyr</td>
<td>90</td>
<td>97</td>
<td>1.44</td>
<td>1.42</td>
<td>1.49</td>
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<tr>
<td>Phe</td>
<td>92</td>
<td>97</td>
<td>2.14</td>
<td>2.24</td>
<td>2.31</td>
</tr>
<tr>
<td>His</td>
<td>92</td>
<td>95</td>
<td>1.58</td>
<td>1.62</td>
<td>1.68</td>
</tr>
<tr>
<td>Lys</td>
<td>95</td>
<td>97</td>
<td>5.23</td>
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<td>Trp</td>
<td>90</td>
<td>97</td>
<td>0.44</td>
<td>0.44</td>
<td>0.58</td>
</tr>
</tbody>
</table>

<sup>1</sup> Values were obtained from the cecrectomized rooster assay (Parsons, 1985).
Diets were formulated to contain 1.60%, 1.40%, and 1.20% total Lys for Phases 1, 2, and 3, respectively, and to meet or exceed the AA ratios suggested by Baker (1997).

Experiment 1

Experiment 1 was conducted as two trials with six treatments and five replications in each trial. In both trials, response variables were ADG, ADFI, and G:F. During Phase 1, pigs were fed a conventional complex nursery diet containing: 1) no SPH or SDPP, 2) 1.5% SPH, 3) 3.0% SPH, 4) 1.5% SDPP, 5) 3.0% SDPP, or 6) 1.5% SPH and 1.5% SDPP. During Phases 2 and 3, all pigs were fed the same diet with no experimental ingredient. The diets are presented in Table 2.

In Trial 1, 150 pigs weaned at 13 to 22 d post farrowing were allotted to one of the above dietary treatments with five pigs per pen. Phases 1, 2, and 3 lasted from d 0 to 8, 8 to 22, and 22 to 29, respectively. In Trial 2, 174 pigs weaned at 20 to 27 d post farrowing were allotted to one of the above dietary treatments with five or six pigs per pen. Phases 1, 2, and 3 lasted from d 0 to 7, 7 to 21, and 21 to 29, respectively.

Experiment 2

Experiment 2 was similar to Exp. 1 except the basal diet contained no mammalian protein (i.e., it did not contain red blood cells). Experiment 2 also consisted of two trials with four treatments and seven replications each. Response variables were ADG, ADFI, and G:F. Phases 1, 2, and 3 lasted from d 0 to 7, 7 to 22, and 22 to 29, respectively. During Phase 1, pigs were fed a conventional complex nursery diet containing: 1) no SPH or SDPP, 2) 1.5% SPH,
<table>
<thead>
<tr>
<th>Ingredient, %</th>
<th>Control</th>
<th>1.5%</th>
<th>3.0%</th>
<th>1.5%</th>
<th>3.0%</th>
<th>1.5%+1.5%</th>
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<tr>
<td>Corn</td>
<td>30.03</td>
<td>31.17</td>
<td>32.31</td>
<td>32.12</td>
<td>34.21</td>
<td>33.26</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>31.77</td>
<td>29.05</td>
<td>26.34</td>
<td>28.19</td>
<td>24.61</td>
<td>25.47</td>
</tr>
<tr>
<td>Whey, dried</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
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<td>5.00</td>
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<td>Dry fat³</td>
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<td>Flavor⁸</td>
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<tr>
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<tr>
<td>SPH</td>
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Calculated composition:

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<th>3,441</th>
<th>3,463</th>
<th>3,471</th>
<th>3,456</th>
<th>3,453</th>
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<td>1.60</td>
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<td>0.91</td>
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<td>0.91</td>
<td>0.91</td>
<td>0.78</td>
<td>0.71</td>
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<tr>
<td>Thr, %</td>
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<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>0.90</td>
<td>0.81</td>
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<tr>
<td>Trp, %</td>
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<td>0.31</td>
<td>0.30</td>
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<td>0.32</td>
<td>0.31</td>
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</tr>
<tr>
<td>Ca, %</td>
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<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
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</tr>
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<td>P, %</td>
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<td>0.80</td>
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<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.70</td>
</tr>
</tbody>
</table>

1 Salmon protein hydrolysate (SPH). SPH batch 1 was used for Trial 1 and SPH batch 2 was used for trial 2.
2 Spray-dried plasma protein (SDPP), American Protein Corporation, Ankeny, IA.
3 Fat Pak 100, Milk Specialties Co., Dundee, IL.
4 AP 301G, American Protein Corp., St. Louis, MO.
(Table 2 continued)
5 Neo-Terra 10/10 for Trial 1 included at 0.75% of the diet and TM 50 for Trial 2 as indicated above, Nutra Blend Corporation, Neosho, MO.
6 Provided the following per kilogram of the diet: Fe, 127 mg; Zn, 127 mg; Cu, 12.7 mg; Mn, 20 mg; I, 0.80 mg; and Se, 0.30 mg.
7 Provided the following per kilogram of the diet: vitamin A, 11,023 IU; vitamin D₃, 3,307 IU; vitamin E, 88 IU; niacin, 88 mg; pantothenic acid, 50 mg; riboflavin, 13 mg; menadione, 8 mg; pyridoxine, 4 mg; thiamin, 4 mg; folic acid, 3 mg; vitamin B₁₂, 61 μg; biotin, 441 μg; vitamin C, 110 μg.
6 Dried Strawberry, Feed Flavors, Inc., Wheeling, IL.
3) 1.5% SDPP, or 4) 1.5% SPH and 1.5% SDPP. During Phases 2 and 3, all pigs were fed the same diet with no experimental ingredient. During the first week of Phase 2, pigs were fed a diet containing Ivermectin (200 mg/kg diet, Merial, Duluth, GA) as a dewormer. The diets are presented in Table 3.

In Trial 1, 164 pigs weaned at 15 to 21 d post farrowing were allotted to one of the above dietary treatments with five or six pigs per pen. In Trial 2, 156 pigs weaned at 16 to 24 d post farrowing were allotted to one of the above dietary treatments with five or six pigs per pen.

Data for both experiments were analyzed as a randomized complete block design using the GLM procedures of SAS (SAS Inst. Inc., Cary, NC). The pen of pigs served as the experimental unit for all data. An alpha level of 0.10 was used to determine significant differences between treatments. The treatment x trial interaction was not significant; therefore it was removed from the statistical analysis.

RESULTS

Experiment 1

The results of Exp. 1 are presented in Table 4. During Phase 1, diet did not affect growth performance \((P > 0.10)\). During Phase 2, ADG and ADFI \((P > 0.10)\) were not affected by diet, but G:F was greater for pigs previously fed 1.5% SPH than those previously fed 3.0% SPH \((P < 0.10)\). During Phase 3, ADG and ADFI \((P > 0.10)\) were not affected by diet, but G:F was greater for pigs previously fed 1.5% SDPP than for those previously fed either the control diet or 3.0% SDPP \((P < 0.10)\). In the overall data, no differences were observed for ADG, ADFI, or G:F \((P > 0.10)\); however, pigs fed the 1.5% level of protein source had a greater G:F
<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>1.5%</th>
<th>1.5%</th>
<th>1.5%+1.5%</th>
<th>1.5%</th>
<th>1.5%</th>
<th>1.5%+1.5%</th>
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</thead>
<tbody>
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<td>Ingredient, %</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Corn</td>
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<td>28.87</td>
<td>30.02</td>
<td>47.68</td>
<td>48.78</td>
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<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Fishmeal, menhaden</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>7.00</td>
<td>7.00</td>
<td>2.00</td>
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<tr>
<td>Lactose</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>3.00</td>
<td>3.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Dry fat^{3}</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>2.00</td>
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<td>0.90</td>
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<tr>
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<td>Trace mineral premix^{6}</td>
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<td>Sodium bentonite</td>
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<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
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<tr>
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<td>0.28</td>
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<tr>
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<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
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<tr>
<td>Choline chloride</td>
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<td>0.05</td>
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<td>0.05</td>
<td>0.05</td>
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<tr>
<td>Flavor^{7}</td>
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<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
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<tr>
<td>DL-met</td>
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<td>0.091</td>
<td>0.084</td>
<td>0.083</td>
<td>0.007</td>
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</tr>
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</tr>
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<td>1.50</td>
<td>1.50</td>
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<td>----</td>
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<td>SPH</td>
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<td>----</td>
<td>1.50</td>
<td>----</td>
<td>----</td>
<td>----</td>
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</tbody>
</table>

Calculated composition:
- Lys, % 1.60 1.60 1.60 1.60 1.40 1.40 1.20
- TSAA, % 0.91 0.91 0.91 0.91 0.78 0.78 0.71
- Thr, % 1.04 1.04 1.05 1.05 0.92 0.92 0.81
- Trp, % 0.33 0.32 0.33 0.32 0.28 0.28 0.25
- Ca, % 0.90 0.90 0.90 0.90 0.90 0.90 0.80
- P, % 0.80 0.80 0.80 0.80 0.80 0.80 0.70

^{1} Salmon protein hydrolysate (SPH). SPH batch 2 was used for trial 1 and SPH batch 3 was used for trial 2.
^{2} Spray-dried plasma protein (SDPP), American Protein Corporation, Ankeny, IA.
^{3} Fat Pak 100, Milk Specialties Co., Dundee, IL.
^{4} TM 50, Nutra Blend Corporation, Neosho, MO.
(Table 3 continued)

5 Provided the following per kilogram of the diet: Fe, 127 mg; Zn, 127 mg; Cu, 12.7 mg; Mn, 20 mg; I, 0.80 mg; and Se, 0.30 mg.

6 Provided the following per kilogram of the diet: vitamin A, 11,023 IU; vitamin D₃, 3307 IU; vitamin E, 88 IU; niacin, 88 mg; pantothenic acid, 50 mg; riboflavin, 13 mg; menadione, 8 mg; pyridoxine, 4 mg; thiamin, 4 mg; folic acid, 3 mg; vitamin B₁₂, 61 μg; biotin, 441 μg; vitamin C, 110 μg.

7 Dried Strawberry, Feed Flavors, Inc., Wheeling, IL.

8 Provided 200 mg/kg diet. Merial, Ltd., Duluth, GA.
than those fed the 3.0% level of protein source \((P < 0.09)\) with no significant difference between protein sources.

**Table 4.** Effect of salmon protein hydrolysate (SPH) and spray-dried plasma protein (SDPP) on growth performance of pigs in Experiment 1

<table>
<thead>
<tr>
<th>Phase</th>
<th>Control</th>
<th>1.5%</th>
<th>3.0%</th>
<th>1.5%</th>
<th>3.0%</th>
<th>1.5% + 1.5%</th>
<th>SEM</th>
</tr>
</thead>
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<tr>
<td>Phase 1, d 0 to 7</td>
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<td></td>
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</tr>
<tr>
<td>ADG, g</td>
<td>148.16</td>
<td>166.62</td>
<td>151.30</td>
<td>156.63</td>
<td>172.06</td>
<td>151.36</td>
<td>12.51</td>
</tr>
<tr>
<td>ADFI, g</td>
<td>240.82</td>
<td>260.74</td>
<td>239.83</td>
<td>247.70</td>
<td>261.88</td>
<td>251.63</td>
<td>12.83</td>
</tr>
<tr>
<td>G:F</td>
<td>0.604</td>
<td>0.634</td>
<td>0.622</td>
<td>0.624</td>
<td>0.655</td>
<td>0.605</td>
<td>0.029</td>
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<td>ADG, g</td>
<td>390.14</td>
<td>401.73</td>
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<td>12.87</td>
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<td>591.95</td>
<td>610.15</td>
<td>583.00</td>
<td>617.48</td>
<td>613.85</td>
<td>16.59</td>
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<tr>
<td>G:F</td>
<td>0.656(^{a,b})</td>
<td>0.680(^a)</td>
<td>0.641(^b)</td>
<td>0.651(^{a,b})</td>
<td>0.653(^{a,b})</td>
<td>0.647(^{a,b})</td>
<td>0.015</td>
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<td>519.87</td>
<td>545.22</td>
<td>552.54</td>
<td>522.08</td>
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<td>869.15</td>
<td>880.07</td>
<td>904.38</td>
<td>23.63</td>
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<tr>
<td>G:F</td>
<td>0.595(^a)</td>
<td>0.606(^{a,b})</td>
<td>0.607(^{a,b})</td>
<td>0.637(^b)</td>
<td>0.596(^a)</td>
<td>0.608(^{a,b})</td>
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</tr>
<tr>
<td>ADG, g</td>
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<td>372.98</td>
<td>370.57</td>
<td>369.15</td>
<td>375.03</td>
<td>374.10</td>
<td>9.20</td>
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<tr>
<td>ADFI, g</td>
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<td>574.61</td>
<td>588.17</td>
<td>571.97</td>
<td>594.23</td>
<td>595.68</td>
<td>14.51</td>
</tr>
<tr>
<td>G:F</td>
<td>0.638</td>
<td>0.650</td>
<td>0.630</td>
<td>0.646</td>
<td>0.631</td>
<td>0.628</td>
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</tr>
</tbody>
</table>

\(^1\) Data are means of 10 replications with five or six pigs per replication. Average initial weight was 6.58 kg.

\(^2\) Level effect, \(P < 0.09\).

\(^a,b\) Treatment means with different superscripts are significantly different, \(P < 0.10\).

**Experiment 2**

The results of Exp. 2 are presented in Table 5. During Phase 1, pigs fed diets containing SDPP had an improved ADG \((P < 0.09)\), ADFI \((P < 0.09)\) and G:F \((P < 0.09)\).

Also, pigs fed diets containing SPH \((P < 0.10)\) had in increased ADFI. During Phase 2, pigs previously fed diets containing SPH had an increased ADFI \((P < 0.10)\). During Phase 3, pigs previously fed diets containing SDPP had an increased ADFI \((P < 0.09)\) and pigs previously fed diets containing SPH had a decreased G:F \((P < 0.10)\). In the overall data, pigs fed diets containing SDPP had an increased ADFI \((P < 0.09)\) and pigs fed diets containing SPH tended to have an increased ADFI \((P = 0.12)\).
Table 5. Effect of salmon protein hydrolysate (SPH) and spray-dried plasma protein (SDPP) on growth performance of pigs in Experiment 2

<table>
<thead>
<tr>
<th>Phase, d 0 to 7</th>
<th>Control</th>
<th>1.5% SPH</th>
<th>1.5% SDPP</th>
<th>1.5% SPH + 1.5% SDPP</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, g</td>
<td>102.58a</td>
<td>103.37a</td>
<td>122.52ab</td>
<td>142.03b</td>
<td>10.34</td>
</tr>
<tr>
<td>ADFI, g</td>
<td>209.38a</td>
<td>211.94a</td>
<td>218.43a</td>
<td>251.13b</td>
<td>10.44</td>
</tr>
<tr>
<td>G:F</td>
<td>0.475a</td>
<td>0.470a</td>
<td>0.548b</td>
<td>0.544b</td>
<td>0.027</td>
</tr>
</tbody>
</table>

Phase 2, d 7 to 22

<table>
<thead>
<tr>
<th>Phase, d 7 to 22</th>
<th>Control</th>
<th>1.5% SPH</th>
<th>1.5% SDPP</th>
<th>1.5% SPH + 1.5% SDPP</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, g</td>
<td>360.13</td>
<td>376.78</td>
<td>360.62</td>
<td>371.56</td>
<td>8.60</td>
</tr>
<tr>
<td>ADFI, g</td>
<td>585.75a</td>
<td>624.05b</td>
<td>602.86ab</td>
<td>625.40b</td>
<td>13.20</td>
</tr>
<tr>
<td>G:F</td>
<td>0.618</td>
<td>0.605</td>
<td>0.599</td>
<td>0.598</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Phase 3, d 22 to 29

<table>
<thead>
<tr>
<th>Phase, d 22 to 29</th>
<th>Control</th>
<th>1.5% SPH</th>
<th>1.5% SDPP</th>
<th>1.5% SPH + 1.5% SDPP</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, g</td>
<td>393.82ab</td>
<td>364.49a</td>
<td>406.41b</td>
<td>388.45ab</td>
<td>16.35</td>
</tr>
<tr>
<td>ADFI, g</td>
<td>728.17ab</td>
<td>701.97a</td>
<td>749.58ab</td>
<td>756.03b</td>
<td>21.51</td>
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<tr>
<td>G:F</td>
<td>0.543</td>
<td>0.514</td>
<td>0.542</td>
<td>0.512</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Overall, 0 to 29

<table>
<thead>
<tr>
<th>Overall, 0 to 29</th>
<th>Control</th>
<th>1.5% SPH</th>
<th>1.5% SDPP</th>
<th>1.5% SPH + 1.5% SDPP</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, g</td>
<td>306.69</td>
<td>307.50</td>
<td>314.28</td>
<td>320.23</td>
<td>7.41</td>
</tr>
<tr>
<td>ADFI, g</td>
<td>528.54ab</td>
<td>540.33ab</td>
<td>542.45ab</td>
<td>566.59b</td>
<td>11.34</td>
</tr>
<tr>
<td>G:F</td>
<td>0.584</td>
<td>0.571</td>
<td>0.581</td>
<td>0.567</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Final Body Weight

| d 29, kg         | 14.36   | 14.41    | 14.58     | 14.77                | 0.214 |

1 Data are means of 14 replications with five or six pigs per replication. Average initial weight was 5.33 kg.
2 SDPP effect, $P < 0.09$.
3 SPH effect, $P < 0.10$.
4 $SPH$ effect, $P = 0.12$.

a,b Treatment means with different superscripts are significantly different, $P < 0.10$.

**DISCUSSION**

The results of Exp. 1 suggested a trend for an increase in ADG, ADFI, and G:F in pigs fed SDPP, but the effect was not significant. Numerous researchers have evaluated SDPP over the last several years. Several of these reported that SDPP improved pig growth performance (Hansen et al., 1993; Rantanen et al., 1994; Smith et al., 1995), but some have reported no effect or a negative effect (Guzik et al., 2002; van Dijk et al., 2002).

In Exp. 2, growth performance was improved by SDPP, which agrees with many reports as reviewed by Coffey and Cromwell (2001). There was also a tendency for the combination of SDPP and SPH to improve pig performance.
Guzik et al. (2002) fed 1.5% SDPP for 8 d during Phase 2 (d 7 to 14 post weaning) and observed decreased ADG, ADFI, and G:F. We fed 1.5% SDPP during Phase 1 and reported no significant differences for ADG, ADFI, and G:F for Exp. 1, but improvements in growth performance in Exp. 2. This suggests that it is more advantageous to feed SDPP during the first week post weaning.

During both Exp. 1 and Exp. 2, SPH did not significantly affect growth performance except for ADFI in Phase 2 of Exp. 2 when SPH resulted in an increase in ADFI. The primary purpose of these experiments was to evaluate SPH as a replacement for SDPP. In Exp. 1, the response to SDPP was negligible; thus it is impossible to determine if SPH was as efficacious as SDPP. However, the comparable response would suggest that the protein quality of SPH was equal to that of the control diet. In Exp. 2, SDPP generally improved growth performance, whereas the response to SPH was not significant. The results of Exp. 2 suggest that SDPP results in greater growth performance than SPH. This response is consistent with numerous other researchers, including that of Veum and Halley (1994) and Richert et al. (1995) who compared fish products to SDPP. The response to SDPP that is often observed in pigs may be due to constituents, such as immunoglobulin G (IgG), that are not serving as a protein source (Pierce et al., 2005).

**CONCLUSION**

Spray-dried plasma protein improved growth performance more than SPH. However, SPH was equal to the control diet and, in some, instances better than the control diet.
INTRODUCTION

Corn is typically the grain source used at the highest concentration in diets for nursery pigs. When compared to milk products, the protein in corn is less digestible. The protein in oat groats has a higher digestibility than that of corn (Mahan and Newton, 1993). Because of these reasons, oats can be a partial replacement for corn. Steam rolled oats are often added to starter diets to increase palatability and to reduce diarrhea (Cromwell et al., 1999). Past research also has reported that pigs fed dehulled oats had greater G:F than those feed whole or roasted oats (Rantanen et al., 1995).

Nutri-Sure (NS) is a by-product of cereal manufacturing. Nutri-Sure is mostly sugar and cooked oat cereal grain (International Ingredient Corporation, St. Louis, MO) and has a higher metabolizable energy compared to corn. Cromwell et al. (1999) reported a greater ADG and ADFI for pigs fed NS compared to those fed steam rolled oats.

The objective of this study was to evaluate the effects of NS, ground oat groats (GOG), ground steam rolled oats (SRO), and feeding oat meal (FOM) on the growth performance of nursery pigs.

MATERIALS AND METHODS

Experiment 1

The LSU Agricultural Center Animal Care and Use Committee approved all methods used in these experiments. Purebred (Yorkshire) or crossbred (Yorkshire x Duroc or Yorkshire x Landrace) nursery pigs from the LSU Agricultural Center Swine Unit were used. Pigs were housed in a thermally controlled enclosed nursery containing 34 pens with hard plastic slotted floors with an under floor flush system for
waste removal. Pigs were offered feed and water ad libitum in a 0.97- x 1.47-m pen. Pigs were allotted to treatment on the basis of ancestry, weight, and sex (as much as possible, there was an equal number of barrows and gilts within each pen). Pigs and feeders were monitored twice daily.

Two batches of each oat product were used in this experiment. Each batch was analyzed for AA content. Amino acids were determined after acid hydrolysis (AOAC, 2000; Method 982.30 E(a)). Total sulfur AA content was determined after performic acid oxidation followed by acid hydrolysis (AOAC, 2000; Method 982.30 E(b)). Tryptophan content was determined after alkaline hydrolysis (AOAC, 2000; Method 982.30 E(c)). Proximate analysis for determination of protein, fat, fiber, ash, moisture, and total sugar and sodium, chloride, calcium, and phosphorus analysis was determined on the first batch by O’Neal Scientific Services, Inc (St. Louis, MO). Proximate analysis for determination of protein, fat, fiber, ash, moisture, and total sugar was determined on the second batch by University of Missouri (Experimental Station Chemical Laboratories, Columbia, MO). The AA and mineral content and proximate analysis for each batch of Nutri-Sure and oats products are presented in Tables 6 and 7.

The diets used in this experiment were formulated on the analyzed values for AA and minerals for Nutri-Sure and the oats products, but on NRC (1998) for all other ingredients. Diets were formulated to contain 1.60%, 1.40%, and 1.50% total Lys for Phases 1, 2, and 3, respectively, and to meet or exceed the AA ratios suggested by Baker (1997).

Experiment 1 was conducted as two trials with five treatments and six replications each. In both trials, response variables were ADG, ADFI, and G:F. During Phases 1, 2, and 3 pigs were fed a conventional nursery diet containing: 1) no oats
Table 6. Amino acid, proximate, and mineral composition (%) of Nutri-Sure, oat groats, steam rolled oats, and feeding oat meal, Trial 1

<table>
<thead>
<tr>
<th></th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
<th>Oat groats (NRC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amino acids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arg</td>
<td>0.48</td>
<td>0.88</td>
<td>0.83</td>
<td>0.88</td>
<td>0.85</td>
</tr>
<tr>
<td>Cys</td>
<td>0.20</td>
<td>0.41</td>
<td>0.42</td>
<td>0.43</td>
<td>0.22</td>
</tr>
<tr>
<td>Gly</td>
<td>0.40</td>
<td>0.66</td>
<td>0.64</td>
<td>0.66</td>
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</tr>
<tr>
<td>His</td>
<td>0.20</td>
<td>0.30</td>
<td>0.29</td>
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<tr>
<td>Ile</td>
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<td>0.48</td>
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<td>0.55</td>
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<tr>
<td>Leu</td>
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<td>0.93</td>
<td>0.97</td>
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<td>0.54</td>
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<td>0.48</td>
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<td>0.23</td>
<td>0.24</td>
<td>0.20</td>
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<tr>
<td>Phe</td>
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<td>0.67</td>
<td>0.64</td>
<td>0.67</td>
<td>0.66</td>
</tr>
<tr>
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<td>0.55</td>
<td>0.56</td>
<td>0.56</td>
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</tr>
<tr>
<td>Thr</td>
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<td>0.42</td>
<td>0.42</td>
<td>0.43</td>
<td>0.44</td>
</tr>
<tr>
<td>Trp</td>
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<td>0.15</td>
<td>0.14</td>
<td>0.14</td>
<td>0.18</td>
</tr>
<tr>
<td>Tyr</td>
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<td>0.39</td>
<td>0.39</td>
<td>0.40</td>
<td>0.51</td>
</tr>
<tr>
<td>Val</td>
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<td>0.67</td>
<td>0.71</td>
<td>0.72</td>
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<td><strong>Proximate analysis</strong></td>
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<td></td>
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<td>Protein</td>
<td>8.58</td>
<td>13.00</td>
<td>12.90</td>
<td>13.00</td>
<td>13.90</td>
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<tr>
<td>Fat</td>
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<td>7.00</td>
<td>6.33</td>
<td>6.64</td>
<td>6.20</td>
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<tr>
<td>Fiber</td>
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<td>2.25</td>
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<tr>
<td>Ash</td>
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<td>1.69</td>
<td>1.64</td>
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</tr>
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<td>Na</td>
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Table 7. Amino acid, proximate, and mineral composition (%) of Nutri-Sure, oat groats, steam rolled oats, and feeding oat meal, Trial 2

<table>
<thead>
<tr>
<th></th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
<th>Oat groats (NRC)</th>
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</thead>
<tbody>
<tr>
<td><strong>Amino acids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arg</td>
<td>0.50</td>
<td>0.76</td>
<td>0.74</td>
<td>0.78</td>
<td>0.85</td>
</tr>
<tr>
<td>Cys</td>
<td>0.18</td>
<td>0.34</td>
<td>0.35</td>
<td>0.35</td>
<td>0.22</td>
</tr>
<tr>
<td>Gly</td>
<td>0.40</td>
<td>0.58</td>
<td>0.58</td>
<td>0.60</td>
<td>---</td>
</tr>
<tr>
<td>His</td>
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<td>0.26</td>
<td>0.26</td>
<td>0.27</td>
<td>0.24</td>
</tr>
<tr>
<td>Ile</td>
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<td>0.44</td>
<td>0.44</td>
<td>0.46</td>
<td>0.55</td>
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<tr>
<td>Leu</td>
<td>0.60</td>
<td>0.86</td>
<td>0.87</td>
<td>0.89</td>
<td>0.98</td>
</tr>
<tr>
<td>Lys</td>
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<td>0.52</td>
<td>0.52</td>
<td>0.54</td>
<td>0.48</td>
</tr>
<tr>
<td>Met</td>
<td>0.12</td>
<td>0.21</td>
<td>0.22</td>
<td>0.22</td>
<td>0.20</td>
</tr>
<tr>
<td>Phe</td>
<td>0.41</td>
<td>0.58</td>
<td>0.59</td>
<td>0.60</td>
<td>0.66</td>
</tr>
<tr>
<td>Ser</td>
<td>0.35</td>
<td>0.51</td>
<td>0.53</td>
<td>0.54</td>
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</tr>
<tr>
<td>Thr</td>
<td>0.26</td>
<td>0.37</td>
<td>0.39</td>
<td>0.40</td>
<td>0.44</td>
</tr>
<tr>
<td>Trp</td>
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<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
<td>0.18</td>
</tr>
<tr>
<td>Tyr</td>
<td>0.23</td>
<td>0.34</td>
<td>0.35</td>
<td>0.36</td>
<td>0.51</td>
</tr>
<tr>
<td>Val</td>
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<td>0.61</td>
<td>0.60</td>
<td>0.63</td>
<td>0.72</td>
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<tr>
<td><strong>Proximate analysis</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>8.52</td>
<td>11.48</td>
<td>10.78</td>
<td>12.22</td>
<td>13.90</td>
</tr>
<tr>
<td>Fat</td>
<td>2.66</td>
<td>4.91</td>
<td>4.73</td>
<td>4.30</td>
<td>6.20</td>
</tr>
<tr>
<td>Fiber</td>
<td>1.31</td>
<td>1.66</td>
<td>3.02</td>
<td>2.18</td>
<td>---</td>
</tr>
<tr>
<td>Ash</td>
<td>4.24</td>
<td>1.63</td>
<td>1.87</td>
<td>1.83</td>
<td>---</td>
</tr>
<tr>
<td>Moisture</td>
<td>5.32</td>
<td>13.57</td>
<td>12.88</td>
<td>13.23</td>
<td>10.00</td>
</tr>
</tbody>
</table>
product, 2) 10% NS, 3) 10% GOG, 4) 10% SRO, or 5) 10% FOM. The diets are presented in Tables 8, 9, and 10.

In Trial 1, 150 pigs weaned at 14 to 23 d post farrowing were allotted to one of the above dietary treatments with five pigs per pen. Phases 1, 2, and 3 lasted from d 0 to 7, 7 to 14, and 14 to 28, respectively. In the second trial, 175 pigs weaned at 15 to 23 d post farrowing were allotted to one of the above dietary treatments with five or six pigs per pen. Phases 1, 2, and 3 lasted from d 0 to 7, 7 to 14, and 14 to 28, respectively.

Data for both experiments were analyzed as a randomized complete block design using the GLM procedures of SAS (SAS Inst. Inc., Cary, NC). The pen of pigs served as the experimental unit for all data. An alpha level of 0.10 was used to determine significant differences between treatments. The treatment x trial interaction was not significant; therefore it was removed from the statistical analysis.

**RESULTS**

Experiment 1

The results of Exp. 1 are presented in Table 11. During Phase 1, diet did not affect growth performance ($P > 0.10$). During Phase 2, ADG and G:F ($P > 0.10$) were not affected by diet, but ADFI was greater for pigs fed GOG or SRO than for those fed NS ($P < 0.09$). During Phase 3, ADG and G:F ($P > 0.10$) were not affected by diet, but ADFI was greater for pigs fed the control diet than those fed FOM ($P < 0.05$). In the overall data, no differences were observed for ADG or ADFI ($P > 0.10$); however, pigs fed NS or SRO had a greater G:F than those fed the control diet ($P < 0.03$). The final body weight of pigs fed SRO was greater than those fed the control diet or FOM ($P < 0.07$).
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control</th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>37.39</td>
<td>28.64</td>
<td>27.70</td>
<td>27.68</td>
<td>27.70</td>
</tr>
<tr>
<td>Soybean meal</td>
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<td>20.98</td>
<td>20.98</td>
<td>20.98</td>
<td>20.98</td>
</tr>
<tr>
<td>Whey, dried</td>
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<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Fishmeal, menhaden</td>
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<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
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<tr>
<td>Lactose</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
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</tr>
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<td>2.00</td>
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<td>2.00</td>
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<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
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<td>0.92</td>
</tr>
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<tr>
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<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
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<td>0.24</td>
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</tr>
<tr>
<td>Choline chloride</td>
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<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
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<td>0.123</td>
<td>0.095</td>
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<td>0.093</td>
</tr>
<tr>
<td>L-thr</td>
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<td>0.020</td>
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<td>0.008</td>
<td>0.006</td>
</tr>
<tr>
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<td>0.036</td>
<td>0.003</td>
<td>0.005</td>
<td>---</td>
</tr>
<tr>
<td>Nutri-Sure</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground oat groats</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground steam rolled oats</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
</tr>
<tr>
<td>Feeding oat meal</td>
<td>---</td>
<td>---</td>
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<td>10.00</td>
</tr>
<tr>
<td>Calculated composition:</td>
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<td></td>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td>ME, kcal/kg</td>
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<td>3,493</td>
<td>3,493</td>
<td>3,493</td>
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<tr>
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<td>1.60</td>
<td>1.60</td>
<td>1.60</td>
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<tr>
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</tr>
<tr>
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<td>1.04</td>
<td>1.04</td>
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<td>1.04</td>
</tr>
<tr>
<td>Trp, %</td>
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<td>0.31</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
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<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>P, %</td>
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<td>0.80</td>
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<td>0.80</td>
</tr>
<tr>
<td>Na, %</td>
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<td>0.47</td>
<td>0.47</td>
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<tr>
<td>Cl, %</td>
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<td>0.59</td>
<td>0.59</td>
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</table>

1 Fat Pak 100, Milk Specialties Co., Dundee, IL.
2 Innomax Porcine RBC, Innovative Proteins: A division of PMI Nutrition International LLC, Brentwood, MO.
3 Spray-dried plasma protein, American Protein Corporation, Ankeny, IA.
4 TM 50, Nutra Blend Corporation, Neosho, MO.
(Table 8 continued)

5 Provided the following per kilogram of the diet: Fe, 127 mg; Zn, 127 mg; Cu, 12.7 mg; Mn, 20 mg; I, 0.80 mg; and Se, 0.30 mg.

6 Provided the following per kilogram of the diet: vitamin A, 11,023 IU; vitamin D₃, 3307 IU; vitamin E, 88 IU; niacin, 88 mg; pantothenic acid, 50 mg; riboflavin, 13 mg; menadione, 8 mg; pyridoxine, 4 mg; thiamin, 4 mg; folic acid, 3 mg; vitamin B₁₂, 61 μg; biotin, 441 μg; vitamin C, 110 μg.
<table>
<thead>
<tr>
<th>Ingredient, %</th>
<th>Control</th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>55.31</td>
<td>46.56</td>
<td>45.62</td>
<td>45.60</td>
<td>45.63</td>
</tr>
<tr>
<td>Soybean meal</td>
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<td>20.01</td>
<td>20.01</td>
<td>20.01</td>
<td>20.01</td>
</tr>
<tr>
<td>Whey, dried</td>
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<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Fishmeal, menhaden</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Dry fat(^1)</td>
<td>2.00</td>
<td>1.04</td>
<td>1.82</td>
<td>1.82</td>
<td>1.82</td>
</tr>
<tr>
<td>Blood cells(^2)</td>
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<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Antibiotic(^3)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
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<td>0.94</td>
<td>0.95</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>Vitamin premix(^4)</td>
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<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Trace mineral premix(^5)</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Sodium bentonite</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Limestone</td>
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<td>0.44</td>
<td>0.53</td>
<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>Salt</td>
<td>0.50</td>
<td>0.35</td>
<td>0.49</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>Choline chloride</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>DL-met</td>
<td>0.075</td>
<td>0.073</td>
<td>0.045</td>
<td>0.045</td>
<td>0.043</td>
</tr>
<tr>
<td>L-thr</td>
<td>0.047</td>
<td>0.046</td>
<td>0.033</td>
<td>0.033</td>
<td>0.032</td>
</tr>
<tr>
<td>L-Lys·HCl</td>
<td>0.057</td>
<td>0.052</td>
<td>0.018</td>
<td>0.020</td>
<td>0.015</td>
</tr>
<tr>
<td>Nutri-Sure</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground oat groats</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground steam rolled oats</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
</tr>
<tr>
<td>Feeding oat meal</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Calculated composition:

<table>
<thead>
<tr>
<th>ME, kcal/kg</th>
<th>3,408</th>
<th>3,408</th>
<th>3,408</th>
<th>3,408</th>
<th>3,408</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lys, %</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
</tr>
<tr>
<td>TSAA, %</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Thr, %</td>
<td>0.91</td>
<td>0.91</td>
<td>0.91</td>
<td>0.91</td>
<td>0.91</td>
</tr>
<tr>
<td>Trp, %</td>
<td>0.26</td>
<td>0.26</td>
<td>0.27</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Ca, %</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>P, %</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Na, %</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Cl, %</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
</tr>
</tbody>
</table>

\(^1\) Fat Pak 100, Milk Specialties Co., Dundee, IL.
\(^2\) Innomax Porcine RBC, Innovative Proteins: A division of PMI Nutrition International LLC, Brentwood, MO.
\(^3\) TM 50, Nutra Blend Corporation, Neosho, MO.
\(^4\) Provided the following per kilogram of the diet: Fe, 127 mg; Zn, 127 mg; Cu, 12.7 mg; Mn, 20 mg; I, 0.80 mg; and Se,
0.30 mg.

5 Provided the following per kilogram of the diet: vitamin A, 11,023 IU; vitamin D₃, 3307 IU; vitamin E, 88 IU; niacin, 88 mg; pantothenic acid, 50 mg; riboflavin, 13 mg; menadione, 8 mg; pyridoxine, 4 mg; thiamin, 4 mg; folic acid, 3 mg; vitamin B₁₂, 61 μg; biotin, 441 μg; vitamin C, 110 μg.
### Table 10. Composition of diets used in Phase 3, as fed basis

<table>
<thead>
<tr>
<th>Ingredient, %</th>
<th>Control</th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>65.71</td>
<td>56.94</td>
<td>56.00</td>
<td>55.99</td>
<td>56.01</td>
</tr>
<tr>
<td>Fishmeal, menhaden</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Dry fat¹</td>
<td>2.00</td>
<td>1.06</td>
<td>1.84</td>
<td>1.84</td>
<td>1.84</td>
</tr>
<tr>
<td>Antibiotic²</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
<td>1.31</td>
<td>1.24</td>
<td>1.24</td>
<td>1.25</td>
<td>1.24</td>
</tr>
<tr>
<td>Vitamin premix³</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Trace mineral premix⁴</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Sodium bentonite</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Limestone</td>
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<td>0.86</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>Salt</td>
<td>0.50</td>
<td>0.35</td>
<td>0.49</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>DL-met</td>
<td>0.032</td>
<td>0.030</td>
<td>0.002</td>
<td>0.002</td>
<td>---</td>
</tr>
<tr>
<td>L-thr</td>
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<td>0.052</td>
<td>0.040</td>
<td>0.040</td>
<td>0.039</td>
</tr>
<tr>
<td>L-Lys·HCl</td>
<td>0.182</td>
<td>0.177</td>
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<td>0.146</td>
<td>0.141</td>
</tr>
<tr>
<td>Nutri-Sure</td>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground oat groats</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ground steam rolled oats</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
</tr>
<tr>
<td>Feeding oat meal</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Calculated composition:

| ME, kcal/kg | 3,364 | 3,364 | 3,364 | 3,364 | 3,364 |
| Lys, %      | 1.20  | 1.20  | 1.20  | 1.20  | 1.20  |
| TSAA, %     | 0.68  | 0.68  | 0.68  | 0.68  | 0.68  |
| Thr, %      | 0.78  | 0.78  | 0.78  | 0.78  | 0.78  |
| Trp, %      | 0.22  | 0.23  | 0.23  | 0.23  | 0.23  |
| Ca, %       | 0.80  | 0.80  | 0.80  | 0.80  | 0.80  |
| P, %        | 0.70  | 0.70  | 0.70  | 0.70  | 0.70  |
| Na, %       | 0.23  | 0.23  | 0.23  | 0.23  | 0.23  |
| Cl, %       | 0.36  | 0.36  | 0.36  | 0.36  | 0.36  |

¹ Fat Pak 100, Milk Specialties Co., Dundee, IL.
² TM 50, Nutra Blend Corporation, Neosho, MO.
³ Provided the following per kilogram of the diet: Fe, 127 mg; Zn, 127 mg; Cu, 12.7 mg; Mn, 20 mg; I, 0.80 mg; and Se, 0.30 mg.
⁴ Provided the following per kilogram of the diet: vitamin A, 11,023 IU; vitamin D₃, 3307 IU; vitamin E, 88 IU; niacin, 88 mg; pantothenic acid, 50 mg; riboflavin, 13 mg; menadione, 8 mg; pyridoxine, 4 mg; thiamin, 4 mg; folic acid, 3 mg; vitamin B₁₂, 61 μg; biotin, 441 μg; vitamin C, 110 μg.
Table 11. Effect of Nutri-Sure, ground oat groats, ground steam rolled oats, or feeding oat meal on growth performance of pigs in Experiment 1

<table>
<thead>
<tr>
<th>Phase 1, d 0 to 7</th>
<th>Control</th>
<th>Nutri-Sure</th>
<th>Oat groats</th>
<th>Steam rolled oats</th>
<th>Feeding oat meal</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG</td>
<td>175.41</td>
<td>176.38</td>
<td>182.88</td>
<td>177.24</td>
<td>186.13</td>
<td>13.02</td>
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<tr>
<td>ADFI</td>
<td>270.39</td>
<td>250.54</td>
<td>263.89</td>
<td>259.43</td>
<td>270.07</td>
<td>12.85</td>
</tr>
<tr>
<td>G:F</td>
<td>0.648</td>
<td>0.693</td>
<td>0.696</td>
<td>0.681</td>
<td>0.689</td>
<td>0.026</td>
</tr>
<tr>
<td>Phase 2, d 7 to 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG</td>
<td>302.00</td>
<td>301.08</td>
<td>317.43</td>
<td>322.97</td>
<td>310.40</td>
<td>16.57</td>
</tr>
<tr>
<td>ADFI</td>
<td>449.74</td>
<td>420.09</td>
<td>452.74</td>
<td>455.19</td>
<td>439.73</td>
<td>12.71</td>
</tr>
<tr>
<td>G:F</td>
<td>0.673</td>
<td>0.704</td>
<td>0.701</td>
<td>0.697</td>
<td>0.705</td>
<td>0.026</td>
</tr>
<tr>
<td>Phase 3, d 14 to 28</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>ADG</td>
<td>397.75</td>
<td>393.89</td>
<td>396.62</td>
<td>399.06</td>
<td>373.52</td>
<td>11.49</td>
</tr>
<tr>
<td>ADFI</td>
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<td>661.23</td>
<td>679.27</td>
<td>679.01</td>
<td>642.05</td>
<td>16.43</td>
</tr>
<tr>
<td>G:F</td>
<td>0.576</td>
<td>0.595</td>
<td>0.584</td>
<td>0.589</td>
<td>0.578</td>
<td>0.010</td>
</tr>
<tr>
<td>Overall, d 0 to 28</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>ADG</td>
<td>318.08</td>
<td>317.62</td>
<td>322.97</td>
<td>327.30</td>
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<td>ADFI</td>
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<td>497.09</td>
<td>514.77</td>
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<td>497.42</td>
<td>12.31</td>
</tr>
<tr>
<td>G:F</td>
<td>0.608</td>
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<td>0.629</td>
<td>0.637</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 28, kg</td>
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<td>14.94</td>
<td>15.18</td>
<td>14.37</td>
<td>0.277</td>
</tr>
</tbody>
</table>

1 Data are means of 12 replications with 5 or 6 pigs per pen. Average initial weight was 5.78 kg.

a,b Treatment means with different superscripts are significantly different, P < 0.10.
DISCUSSION

Many feeding guides recommend that oat products be included at approximately 8 to 10% in nursery pig diets (Swine Nutrition Guide, 2000; Tri-State Swine Nutrition Guide, 1998; Walker and Myer, 2003). Cromwell et al. (1999) fed either 10% NS or 10% SRO and reported no significant differences for the first 7 d post weaning, which agree with our data. Overall, Cromwell et al. (1999) reported that pigs fed NS had a greater ADG and ADFI than those fed the control diet, but feed:gain was not affected by diet. Growth performance was not affected in pigs fed SRO. In our overall data, ADG and ADFI were not affected by diet; however, pigs fed NS or SRO had an increased G:F compared to pigs fed the control diet.

Guzik et al. (2002) fed 8.43% FOM for 8 d during Phase 2 (d 7 to 14 post weaning) and reported a decrease in ADG and ADFI, but no significant difference for G:F. We observed no significant differences between the control diet and FOM.

Nicholls and Aherne (1984) fed 0, 5, 10, 15, and 20% oat groats for 28 d and reported no differences in ADG, ADFI, or G:F between any of the diets. Our work agrees with these findings.

The results of Exp. 1 suggest that NS or SRO results in greater growth performance than the control diet, GOG, or FOM.

CONCLUSION

Our results indicate that pigs fed diets containing each of the oat products tested performed as well as pigs fed the control diet, suggesting that any of these oat products are sufficient partial replacements for corn. However, pigs fed NS or SRO had the greatest overall G:F.
CHAPTER 5
SUMMARY

This research was conducted to evaluate different feed additives in diets for nursery pigs. The various feed additives included salmon protein hydrolysate (SPH), spray-dried plasma protein (SDPP), Nutri-Sure (NS), ground oat groats (GOG), ground steam rolled oats (SRO), and feeding oat meal (FOM).

In the first experiment comparing SPH and SDPP, pigs were fed a conventional complex Phase 1 nursery diet containing: 1) no SPH or SDPP, 2) 1.5% SPH, 3) 3.0% SPH, 4) 1.5% SDPP, 5) 3.0% SDPP, or 6) 1.5% SPH and 1.5% SDPP. No significant differences were observed during Phase 1. Overall, we observed no significant differences for ADG or ADFI, but pigs fed 1.5% of either protein source had a greater G:F when compared to the 3.0% level of inclusion.

In the second experiment comparing SPH and SDPP, pigs were fed a conventional complex Phase 1 nursery diet (with no mammalian tissue protein) containing: 1) no SPH or SDPP, 2) 1.5% SPH, 3) 1.5% SDPP, or 4) 1.5% SPH and 1.5% SDPP. There was an increased ADG, ADFI, and G:F during Phase 1 for pigs fed SDPP. Also in Phase 1, there was an increased ADFI in pigs fed SPH. Overall, there were no significant effects on ADG or G:F, but pigs fed SDPP had an increased ADFI and pigs fed SPH tended to have an increased ADFI.

In the third experiment comparing oat products, pigs were fed a conventional nursery diet containing: 1) no oats product, 2) 10% NS, 3) 10% GOG, 4) 10% SRO, or 5) 10% FOM. There was no effect of diet during Phase 1. During Phase 2, ADFI was greater for pigs fed SRO or GOG than for pigs fed NS. During Phase 3, ADFI was greater for pigs fed the control than for pigs fed FOM. Overall, pigs fed NS or SRO had a greater G:F than pigs fed the control diet.
These results suggest that any of the feed additives tested will make good additions to diets for nursery pigs. They all proved to be at least as good as the control diets and sometimes better than the control diets.
REFERENCES


VITA

Jennifer L. Tucker, better known as Jenny, was born on December 21, 1980, in El Dorado, Arkansas. Jenny grew up in McNeil, Arkansas, after moving there at the age of 4. She graduated in May 1999 from Columbia Christian School. In August of 2004, she graduated from Southern Arkansas University in Magnolia, Arkansas, with a bachelor’s degree in biology. Just two weeks after graduation Jenny began her pursuit of a master’s of animal science in non-ruminant nutrition.