# THE EFFECTS OF DIETARY SOY PROTEIN SOURCE FED TO THE EARLY-WEANED PIG ON SUBSEQUENT GROWTH PERFORMANCE[1]

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## Summary

Two hundred and ninety five pigs (initially 12.3 lb and 21 d of age) were used to determine the effect of different soy protein sources fed during phase I on subsequent growth performance. Dietary treatments were based on different soy protein sources added to the phase I (d 0 to 14 postweaning) diet. Pigs were fed one of five experimental treatments: 1) control diet (casein); 2) moist extruded soy protein concentrate (MESPC); 3) soybean meal (SBM); 4) soy protein concentrate (SPC); 5) moist extruded soy flour (MESF). The phase I diet contained 20% dried whey (DW), 7.5% spray dried porcine plasma (SDPP), and 1.75% spray dried blood meal (SDBM) and was formulated to contain 1.6% lysine, .44% methionine, and 14.4% lactose. From d 14 to 28 postweaning (phase II), all pigs were fed a common (1.25% lysine) corn-SBM diet containing 2.5% SDBM and 10% DW. During phase I, no differences occurred in average daily gain (ADG) or feed efficiency (F/G) between any experimental treatments. However, pigs fed the MESPC-based diet had higher average daily feed intakes (ADFI) when compared to pigs fed either SBM or MESF. From d 14 to 28, pigs fed MESPC during phase I, had higher ADG when compared to the performance of pigs fed SPC and MESF and higher ADFI when compared with pigs receiving the other experimental treatments. Pigs fed SBM during phase I had improved F/G compared to SPC and MESPC. Cumulative data (d 0 to 28 postweaning) indicated that pigs fed the diet containing MESPC during phase I had numerically higher ADG and ADFI when compared to pigs fed the MESF or SPC treatments; however, MESPC pigs were less efficient. Feed cost per pound of gain was the lowest for pigs fed SBM during phase I for overall performance. Pigs fed MESPC in phase I had numerically higher ADG and were 1.4 lb heavier at the end of the trial. However, this advantage would cost an additional $2.00 for feed. In summary, economics and performance must be considered before deciding to use SBM or MESPC in the phase I diet. Our results indicate no advantage in using SPC or MESF in the phase I diet.

## Introduction

The appropriate source and level of soybean protein to use in the diet for the early-weaned pig constitute a major controversy in the swine industry. The controversy centers on whether the first diet after weaning should contain any soybean protein, and if soybean protein is used, should it be a further processed soybean product or soybean meal. The answers to these questions have a major impact on the cost of the early weaning diet. This diet typically costs $750 to $1,250 per ton when purchased as a complete feed. From a cost

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standpoint, it would be advantageous to use soybean meal in this diet.

In previous research at Kansas State University, we demonstrated that pigs fed diets containing high levels of soybean meal during the first 2 weeks postweaning gained slower and less efficiently than pigs fed an all milk-based diet. However, when switched to a common corn-soybean meal diet on d 14 postweaning, pigs that were fed the milk-based diet from d 0 to 14 had decreased ADG and ADFI. Therefore, we concluded that the diet for the early-weaned pig must contain some soybean protein to allow the pig to became adjusted to soybean meal. Further trials indicated that the diet could contain 15 to 20% soybean meal without a severe reduction in performance. However, many nutritionists and most feed companies are worried about adverse reactions to soybean meal and, thus, use a further processed soybean protein (soy protein concentrate, moist extruded soy protein concentrate, or moist extruded soy flour) as the protein source instead of soybean meal. These products increase the cost of the diet by $100 to $150 per ton.

Therefore, this experiment was designed to answer the practical question of whether the complex starter diet for the young pig should contain soybean protein and whether the source of the soy protein should be soybean meal, soy protein concentrate, moist extruded soy protein concentrate or moist extruded soy flour.

## Procedures

A total of 295 pigs (initially 12.3 lb and 21-d of age) were used in a 28-d growth assay. Pigs were blocked by weight to give three blocks with six pigs/pen and four blocks with 13 pigs/pen. This was due to the variation in the number of pigs weaned per week on the commercial swine operation in which this experiment was conducted. There were seven pens/experimental treatment.

Experimental diets were fed in two phases. During phase I, pigs were fed one of five experimental diets. Dietary treatments consisted of a control diet that contained casein as the protein source and four other treatments that contained different soy protein sources. The soy protein sources that were evaluated included: 1) moist extruded soy protein concentrate, 2) soybean meal, 3) soy protein concentrate, and 4) moist extruded soy flour. All phase I diets contained 7.5% SDPP, 1.75% SDBM, and 20% DW. Moist extruded soy protein concentrate, SBM, soy protein concentrate, and moist extruded soy flour replaced casein on a equal lysine basis (Table 1). The phase I diet was formulated to contain 1.6% lysine, .44 % methionine, and 14.4% lactose.

A common diet was fed to all pigs during phase II (Table 1). This diet was corn-soybean meal-based and contained 2.5% spray-dried blood meal and 10% dried whey. All phase I diets were fed in a pelleted form. The phase II diet was fed in a meal form.

Pigs were housed in an environmentally controlled nursery room. Temperature was maintained at approximately 90°F for the first week of the trial and lowered approximately 5°F per week to maintain pig comfort. Pigs had ad libitum access to food and water. Pigs were weighed and feed disappearance was recorded on d 7, 14, 21, and 28 postweaning to determine ADG, ADFI, and F/G.

## Results and Discussion

During d 0 to 14 postweaning, no differences occurred in ADG and F/G between any treatment means (Table 2). However, pigs receiving the diet containing MESPC had higher ($P<.10$) ADFI when compared to pigs fed either SBM or MESF. Also during this phase I period, pigs on the SBM treatment had the lowest numerical feed cost per pound of gain.

From d 14 to 28, pigs fed MESPC during phase I had higher ADG (P<.10) when compared with pigs fed SPC and MESF. Additionally, pigs fed MESPC during phase I had greater feed intakes (P<.10) compared with pigs fed other protein sources. However, pigs fed the SBM treatment were the most efficient, with the casein and MESF treatments being intermediate. The pigs fed the SBM treatment also had the lowest feed cost per pound of gain. Cumulative data (d 0 to 28 postweaning) indicate that pigs fed the MESPC during phase I had higher ADG (P<.10) and ADFI (P<.09) when compared to the pigs on the MESF or SPC treatments. No differences occurred in ADG between the casein, MESPC, or SBM treatments. Although, the MESPC treatment had the highest ADFI (P<.10), pigs were less efficient than pigs fed the diet containing SBM. Feed cost per pound of gain over the 28-d growth period was lowest for pigs fed the diet containing SBM.

Pigs fed MESPC in phase I had numerically higher ADG and were 1.4 lb heavier at the end of the trial. However, this advantage would cost an additional $2.00 for feed. In summary, economics and performance must be considered before deciding to use SBM or MESPC in the phase I diet. Our results indicate no advantage in using SPC or MESF in the phase I diet.

**Table 1. Diet Composition, %[a]**

| Item | Casein | MESPC[b] | SBM[c] | SPC[d] | MESF[e] | Phase II |
|---|---|---|---|---|---|---|
| Corn | 52.35 | 47.06 | 41.91 | 47.06 | 42.30 | 57.45 |
| SBM (48.5%) | -- | -- | -- | -- | -- | 22.63 |
| Soy protein[f] | 9.09 | 14.26 | 19.61 | 14.26 | 19.09 | -- |
| Dried whey | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 10.00 |
| Soybean oil | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 3.00 |
| SD porcine plasma | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | -- |
| Monocal phosphate | 1.96 | 1.93 | 1.85 | 1.93 | 1.91 | 1.95 |
| SD blood meal | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 | 2.50 |
| Limestone | .73 | .80 | .68 | .80 | .76 | .82 |
| Vitamin premix | .25 | .25 | .25 | .25 | .25 | .25 |
| Trace mineral premix | .15 | .15 | .15 | .15 | .15 | .15 |
| L-lysine HCl | .012 | .10 | .10 | .10 | 1.00 | .10 |
| DL-methionine | .075 | .075 | .075 | .075 | .075 | .08 |
| Copper sulfate | .012 | .135 | .135 | .135 | .138 | .08 |
| L-cystine | .075 | -- | -- | -- | -- | -- |
| Antibiotic[g] | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

[a]All phase I diets were formulated to contain 1.6% lysine, .44% methionine, .90% Ca, and .80% P; the phase II diet contained 1.25% lysine and .36% methionine.
[b]MESPC = moist extruded soy protein concentrate.
[c]SBM = soybean meal (48.5%).
[d]SPC = soy protein concentrate.
[e]MESF = moist extruded soy flour.
[f]Column heading represents product used.
[g]Provided 50g/ton carbadox.

**Table 2. Performance of Pigs Receiving Different Soy Sources during Phase I[a]**

| Item | Casein | MESPC[b] | SBM[c] | SPC[d] | MESF[e] | CV |
|---|---|---|---|---|---|---|
| d 0 to 14 | | | | | | |
| ADG | .65 | .65 | .57 | .59 | .58 | 16.1 |
| ADFI | .66[f,g] | .68[f] | .60[g] | .61[f,g] | .59[g] | 13.9 |
| F/G | 1.03 | 1.04 | 1.06 | 1.04 | 1.02 | 6.0 |
| d 14 to 28 | | | | | | |
| ADG | 1.05[f,g,h] | 1.10[f] | 1.08[f,g] | 1.02[g,h] | 1.00[h] | 7.37 |
| ADFI | 1.64[g] | 1.82[f] | 1.65[g] | 1.65[g] | 1.58[g] | 8.00 |
| F/G | 1.58[f,g,h] | 1.65[f] | 1.53[h] | 1.62[f,g] | 1.58[f,g,h] | 5.01 |
| d 0 to 28 | | | | | | |
| ADG | .85[f,g] | .88[f] | .83[f,g] | .81[g] | .79[g] | 9.4 |
| ADFI | 1.15[f] | 1.25[g] | 1.12[f] | 1.13[f] | 1.08[f] | 9.0 |
| F/G | 1.37[f,h] | 1.42[g] | 1.37[h,f] | 1.41[f,g,h] | 1.37[f,g,h] | 3.5 |
| Ingredient cost/ton, $[i,j] | 935.00 | 641.00 | 515.00 | 636.00 | 629.00 | |
| Cost/lb of gain, $ | | | | | | |
| d 0 to 14 | .48 | .33 | .27 | .33 | .32 | |
| d 14 to 28 | .18 | .18 | .17 | .18 | .18 | |
| d 0 to 28 | .29 | .26 | .19 | .24 | .22 | |

[a]Two hundred and ninety five weanling pigs were used (initially 13.3 lb and 21 d of age), 6 or 13 pigs/pen with 7 pens per treatment.
[b]MESPC = moist extruded soy protein concentrate.
[c]SBM = soybean meal (48.5%).
[d]SPC = soy protein concentrate.
[e]MESF = moist extruded soy flour.
[f,g,h]Means in row not bearing a common superscript differ (P<.10).
[i]Ingredient cost used were corn, $.04 per lb; casein, $2.51 per lb; MESPC, $.57 per lb; SBM, $.107 per lb; SPC, $.53 per lb; MESF, $.38 per lb.
[j]Phase II diet cost was $224.