

## EFFECTS OF SOYBEAN MEAL PARTICLE SIZE ON GROWTH PERFORMANCE OF NURSERY PIGS<sup>1</sup>

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### Summary

A total of 360 pigs were used in two experiments to determine the effects of decreasing particle size of soybean meal on nursery pig performance. In Exp. 1, pigs were fed diets containing 34% extruded-expelled soybean meal ground to 965, 742, or 639 microns. In Exp. 2, pigs were fed the same diet containing solvent extracted soybean meal ground to 1226, 797, or 444 microns. Decreasing soybean meal particle size did not influence pig growth performance in either study.

(Key Words: Pigs, Soybean Meal, Particle Size.)

### Introduction

Reducing particle size of grain in swine diets increases surface area allowing for greater interaction with digestive enzymes and improved digestibility. We recommend a particle size of 600 to 700 microns for grain in diets to optimize growth performance and improve feed efficiency. While it has been confirmed that fine grinding of grain in swine diets optimizes performance, there is limited information on the effects of soybean meal particle size on pig performance.

Researchers at The Ohio State University observed that decreasing soybean meal particle size resulted in improved amino acid

digestibility in growing-finishing diets. Therefore, our objective was to evaluate the influence of reducing particle size of extruded-expelled soybean meal and solvent extracted soybean meal on growth performance of nursery pigs.

### Procedures

A total of 360 pigs (initially 20.9 lb and  $35 \pm 3$  d of age) were used in two 21-d growth assays. There were six pigs/pen and 10 pens per treatment. Pigs were fed the same SEW diet for 7 d after weaning, followed by a common Phase 2 diet from d 7 to 14. On d 14, all pigs were weighed and blocked by weight and allotted to one of three dietary treatments. All diets were corn-soybean meal-based and formulated to 1.2% lysine, 0.78% calcium, and 0.40% available phosphorus (Table 1). In Exp. 1, we used a single lot of extruded-expelled soybean meal ground to achieve particle sizes of 965, 742, or 639 microns, which resulted in whole diet particle sizes of 728, 719, and 697 microns. In Exp. 2, we used one lot of solvent extracted soybean meal ground to achieve particle sizes of 1,226, 797, and 444 microns, which resulted in whole diet particle sizes of 732, 681, and 629, respectively.

All pigs were housed in the KSU Swine Teaching and Research Center's environmentally controlled nursery, with a self-feeder and nipple waterer in each pen to allow ad libitum access to feed and water.

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<sup>1</sup>Appreciation is expressed to North Central Kansas Processors, Washington, KS, and Cargill, Inc., Kansas City, KS, for providing the extruded-expelled soybean meal and the solvent extracted soybean meal, respectively.

<sup>2</sup>Food Animal Health and Management Center.

Average daily gain, average daily feed intake, and feed efficiency were determined by weighing pigs and measuring feed disappearance on d 7, 14, and 21 of the experiment.

**Table 1. Experimental Diets (fed from d 14 to 35 after weaning)<sup>a</sup>**

| Ingredient, %                 |        |
|-------------------------------|--------|
| Corn                          | 61.90  |
| Soybean meal <sup>b</sup>     | 34.41  |
| Monocalcium phosphate (21% P) | 1.50   |
| Limestone                     | 0.95   |
| Salt                          | 0.35   |
| Vitamin premix                | 0.25   |
| Trace mineral premix          | 0.15   |
| Mecadox <sup>c</sup>          | 0.50   |
| Total                         | 100.00 |
| Calculated analysis, %        |        |
| Lysine                        | 1.20   |
| Isoleucine:lysine ratio       | 74     |
| Met & Cys:lysine ratio        | 59     |
| Threonine:lysine ratio        | 68     |
| Tryptophan:lysine ratio       | 22     |
| Valine:lysine ratio           | 85     |
| Protein                       | 21.3   |
| Calcium                       | .77    |
| Phosphorus                    | .73    |
| Available phosphorus          | .39    |

<sup>a</sup>Values calculated on an as-fed basis.

<sup>b</sup>Diets in Exp.1 contained extruded-expelled soybean meal (46.0% CP) and Exp. 2 contained solvent extracted soybean meal (46.5% CP).

<sup>c</sup>Provided 25g/ton carbadox.

Physical properties of ingredients can affect their flowability in holding bins and feeders. Particle size is correlated with flowability; as particle size increases flowability improves, and as particle size decreases flowability becomes poorer. The flowability of a diet is measured by angle of repose. Angle of repose is defined as the maximum angle (degrees) at which a pile of material retains its slope. Thus, a product with a high angle of repose would be expected to flow poorly, and a product with

low angle of repose would flow more freely. In order to determine if particle size would affect flowability, we measured angle of repose on both soybean meal and complete diets.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Linear and quadratic polynomial contrasts were used to determine the effects of soybean meal particle size. Both experiments had matching design with the exception that Exp.1 used extruded-expelled soybean meal and Exp. 2 used solvent extracted soybean meal

## Results and Discussion

In Exp. 1, reducing particle size of extruded-expelled soybean meal (965 to 639 microns) increased the angle of repose. However, the angle of repose of the complete diets was greater than for the soybean meals. This would indicate that reducing particle size of soybean meal does not have a major impact on its flow characteristics relative to the complete diet. In addition, the differences in extruded-expelled soybean meal particle size resulted in approximately a 30-micron difference in the complete diet. Therefore, we would not expect a large difference in feed efficiency and no differences ( $P>0.10$ ) in pig performance were found.

In Exp. 2, reducing particle size of solvent extracted soybean meal (1,226 to 444 microns) increased the angle of repose as in Exp. 1. The angle of repose of the complete diets in Exp. 2 was also greater than for the soybean meal diets, which indicates that the 444 micron soybean meal used in our study actually had a lower angle of repose (greater flowability) than the complete diet with a particle size of 629 microns. The change in soybean meal particle size from 1,226 to 444 microns resulted in a change in overall diet particle size of approximately 100 microns. However, like in Exp. 1, decreasing soybean meal particle size had no affect on pig performance.

Previous research from The Ohio State University has shown that apparent digest-

ibility of amino acids increased as soybean meal particle size decreased. While decreasing soybean meal particle size may improve amino acid digestibility, we did not observe differences in growth performance. If our diets were formulated above the pig's lysine requirement, the changes in amino acid digestibility may not result in improved pig performance. We also might expect the digestible energy content of the diet to increase slightly with finely ground soybean

meal, but again, because of the relatively low inclusion of soybean meal in the diets relative to grain, we were not able to detect any differences in pig performance.

In conclusion, while it is extremely important to finely grind the grain portion of swine diets to a particle size of 600 to 700 microns, based on the results of these two studies, soybean meal particle size does not appear to affect pig growth performance.

**Table 2. Effects of Extruded-Expelled Soybean Meal Particle Size on Growth Performance (Exp. 1)**

| Item                         | Soybean Meal Particle Size, Microns |       |       |       | P Values  |        |           |
|------------------------------|-------------------------------------|-------|-------|-------|-----------|--------|-----------|
|                              | 639                                 | 742   | 965   | SEM   | Treatment | Linear | Quadratic |
| Angle of repose <sup>b</sup> |                                     |       |       |       |           |        |           |
| Soybean meal                 | 51.9                                | 48.00 | 44.19 | —     | —         | —      | —         |
| Diet                         | 55.64                               | 55.07 | 52.38 | —     | —         | —      | —         |
| Diet particle size           | 697                                 | 719   | 728   | —     | —         | —      | —         |
| Day 0 to 21                  |                                     |       |       |       |           |        |           |
| ADG, lb                      | 1.19                                | 1.18  | 1.19  | 0.27  | 0.97      | 0.97   | 0.82      |
| ADFI, lb                     | 1.88                                | 1.92  | 1.95  | 0.037 | 0.45      | 0.22   | 0.83      |
| F/G                          | 1.59                                | 1.63  | 1.65  | 0.029 | 0.37      | 0.18   | 0.65      |

<sup>a</sup>One hundred and eighty (PIC line C22 × 326, initially 20.1 lb and 35 day of age) were used with six pigs per pen and 10 replications (pens) per treatment.

<sup>b</sup>The maximum angle in degrees at which a pile of material retains its slope. The higher the value the poorer the flowability.

**Table 2. Effects of Solvent Extracted Soybean Meal Particle Size on Growth Performance (Exp. 2)**

| Item                         | Soybean Meal Particle Size, Microns |       |       |      | P Values  |        |           |
|------------------------------|-------------------------------------|-------|-------|------|-----------|--------|-----------|
|                              | 444                                 | 797   | 1,226 | SEM  | Treatment | Linear | Quadratic |
| Angle of repose <sup>b</sup> |                                     |       |       |      |           |        |           |
| Soybean meal                 | 38.52                               | 30.68 | 30.85 | —    | —         | —      | —         |
| Diet                         | 53.43                               | 57.20 | 53.80 | —    | —         | —      | —         |
| Diet particle size           | 629                                 | 681   | 732   | —    | —         | —      | —         |
| Day 0 to 21                  |                                     |       |       |      |           |        |           |
| ADG, lb                      | 1.06                                | 1.07  | 1.06  | 0.21 | 0.90      | 0.87   | 0.68      |
| ADFI, lb                     | 1.62                                | 1.63  | 1.62  | 0.27 | 0.93      | 0.96   | 0.70      |
| F/G                          | 1.53                                | 1.52  | 1.52  | 0.13 | 0.85      | 0.60   | 0.82      |

<sup>a</sup>One hundred and eighty (PIC line C22 × 326, initially 21.7 lb and 35 day of age) were used with six pigs per pen and 10 replications (pens) per treatment.

<sup>b</sup>The maximum angle in degrees at which a pile of material retains its slope. The higher the value the poorer the flowability.