SWINE UPDATE

K-STATE Kansas State University

Animal Sciences & Industry

November 2001 Vol. 23, No. 5

Study compares accuracy of particle analysis methods

by Allen Baldrige

The particle size of grain fed to swine and poultry has a major impact on feed efficiency. Because of the economic importance of particle size, nutritionists and consultants recommend frequent particle size analysis. The standard method for determining particle size is time consuming and requires a large initial investment. As a result, many swine producers have used a fast, simple, one-sieve method for determining particle size. The one-screen method, although not as precise as the standard method, was thought to be a suitable alternative to the standard procedure. But recently, variability in results between the one sieve and standard method of particle size analysis have raised doubts about the accuracy of the one-sieve method. In response, we developed a three-sieve method for analyzing particle size. The objective of our experiments was to compare results of a one- and three-sieve particle size analysis method to the standard Ro-Tap tester equipped with a 13-seive stack. A second objective was to determine shaking time required for the three-sieve method.

In the first experiment, we tested the appropriate shaking time for our three-sieve method. The ground corn (50 g) was placed on a stack of three sieves: US #12 (1700 µm), #30 (600 µm), and #50 (300 µm). There was one ball and one carnucle on the #30 sieve and one ball and two carnucles on the #50 sieve. A lightweight lid was placed on top of the stack to prevent spilling while a small pan was added on bottom to collect dust. The sieves were shaken vigorously by hand for five 30-second intervals. The sample left on each screen was then weighed between each interval. This was repeated for 10 different corn samples. We found that most of the grain passed through the screens during the first minute and a half of shaking. This amount of time was both effective and practical (from the shaker's standpoint). We used 1.5 minutes as the shaking time in Experiment 2.

In Experiment 2, we compared three different methods for determining particle size. First, we determined particle size on 44 samples of ground corn using a Ro-Tap tester equipped with a 13-sieve stack in the K-State swine lab. The corn samples ranged from 422 to 1143 microns in particle size. We also determined particle size for these same samples using the one-sieve particle analysis kit (IFA, Stanly, IA). In this analysis, 280 g (10 oz) of ground corn was placed on a #14 size sieve (1400µm). The sieve was shaken by hand until it appeared that all the small particles had fallen through the screen. The sample was weighed, and an average particle size was predicted by comparing the amount remaining on the screen to an equation we calculated from the information provided with the kit. We also developed a regression equation from the actual Ro-Tap results to improve the prediction with the one-sieve system.

Finally, we determined particle size using the three-sieve method described in Experiment 1. The sample remaining on each sieve was weighed, and then regressed to determine a predicted equation for particle size with the

See **PARTICLE** page 2

Swine Industry Day is Nov. 15

Swine industry advances will be presented in Manhattan at the Kansas State University Swine Day, held in conjunction with Kansas Pork Congress-Trade Show, Nov. 15 at the Manhattan Holiday Inn and Holidome.

The morning program starts at 9 a.m. and will feature K-State's swine extension group discussing new research to help producers improve the net returns of their businesses. Topics will include new premix specifications, Phytase®, Carni-chrome®, plasma irradiation, new fishmeal sources, Paylean®, new corn hybrids, phosphorus needs of lean genetics, and nutrient composition of Kansas swine lagoons.

Barry Flinchbaugh, professor of agricultural economics, will discuss the latest developments on the new farm bill in the afternoon. Contact the Department of Animal Sciences, (785) 532-1267, for more information.

PARTICLE, from page 1

following equation providing the best fit: Particle Size = 18.892(X#12) + 10.870(X#30) + 1.1827(X#50) – 149.978 (R2=.88); where X equals the percentage of sample on the respective screens. Predicted average particle sizes by the one- and three-sieve methods were then compared to the particle size determined by the standard procedure using the Ro-Tap tester.

Of the 44 samples used in Experiment 2, the one-sieve method was only able to predict 11 (25%) of the samples within 75 microns of their actual size using the regression equation provided by the manufacturer (Table 1). Its prediction was off by more than 150 microns on 18 samples (41%), 12 of which were predicted over 200 microns from the actual particle size. Using a regression formula developed from the actual Ro-Tap analysis for the one-sieve method, particle size was predicted slightly better with 11 samples (25%) off by more than 100 microns.

The three-sieve method predicted 40 of the 44 samples (91%) to within 75 microns and only 1 sample was off by more than 150 microns. The advantage to the three-sieve method is that it requires no more time in shaking than the one-sieve so it will be almost as fast. But there will be slightly more initial expense because three screens must be purchased. From our results, the three-sieve method appears to be more accurate than the one-sieve procedure.

While the three-sieve method predicts the average particle sizes more accurately than the one-sieve, it is still not as precise as the standard Ro-tap tester and 13-sieve stack. If using either the one- or three-sieve methods, we recommend conducting multiple tests. In addition, samples should be sent periodically (for example, once a month) to a laboratory that regularly performs particle-size analysis to verify results of either the one- or three-sieve method.

Table 1. Accuracy of particle size prediction (percentage of samples within each deviation category)

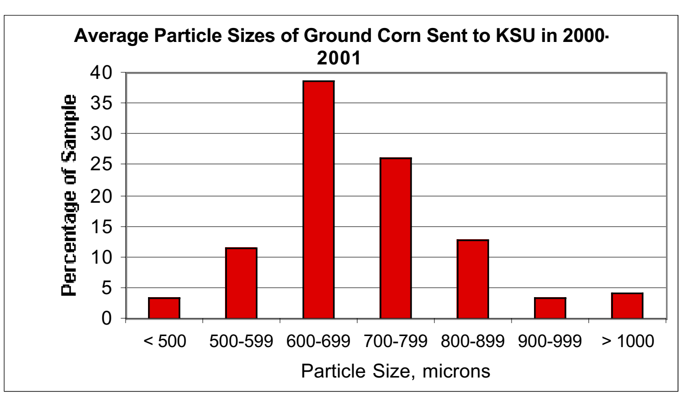
Deviation from Ro-tap analysis, microns	One-sieve method: Kit analysis	One-sieve method: Regression	3-sieve method
< 25	5%	14%	32%
25 to 50	9%	14%	25%
50 to 75	11%	27%	34%
75 to 100	16%	20%	5%
100 to 150	18%	20%	2%
150 to 200	14%	5%	2%
> 200	27%	0%	0%

Have You Measured Particle Size Lately?

by Malachy Young

Most pork producers understand the impact of particle size on feed efficiency. As particle size is reduced, digestibility of the diet increases and feed efficiency is improved. Kansas State University recommends particle size be maintained between 600 and 800 microns with an optimal range of 650 to 750 microns. Larger particle sizes result in poor feed efficiency, while smaller particle sizes increase the energy cost of grinding, susceptibility to ulcers, and problems with feeders and bins bridging.

We have been collecting data from corn samples sent to the swine lab at K-State for particle-size analysis. Generally, particle size has improved over the years. Of more than 2,500 samples collected between 1986 and 1992, only 21% of the samples received fell within the recommended particle size of 600 to 800 microns. For the 670 corn samples received in the last 18 months, almost 65% of the samples have been between 600 and 800 microns.



However, more than 35% of the samples are still outside of the normal range. The improvement in particle size is good, but deceiving. The main problem with this data set is that a relatively few producers account for a majority of the samples being tested. Some larger producers have taken particle size very seriously and instituted monthly sampling and testing to ensure that they remain within the optimal range. Relatively few producers in Kansas have analyzed particle size routinely over the last few years.

Particle size of the diet can have a huge economic impact in your cost of production. For every 100 microns your particle size is greater than the recommend range, the cost for poorer feed efficiency will be about $.50 per pig. For example, if you haven't checked your particle size recently, and it has crept up to 1,000 microns, reducing particle size to 700 microns will save you $1.50 for every finishing pig marketed. Ensuring proper particle size can easily be accomplished through routine maintenance like changing hammer mill screens or turning hammers. Adjusting the gap between rolls and regrooving rolls in roller mills should also be preformed regularly.

Particle size analysis can be performed by Kansas State University for $10 each. About one half pound of sample should be sent to: Kansas State University,206 Weber Hall, Manhattan, KS 66506 Results will be sent out within 10 working days upon the arrival of the sample to the laboratory. For more information call (785) 532-1277.

Copper Sources as Growth Promoters in Grow-Finish Diets

by Chad Hastad

Many swine production systems use copper sulfate as a growth promoter in growing and finishing diets. Recent research also indicates that tribasic copper chloride is as effective as copper sulfate as a growth promoter in nursery pig diets. Previous trials have shown that lower levels of tribasic copper chloride can be used to yield results similar to copper sulfate. The main advantage of the copper chloride is that it can lower feed cost, because of the significant decrease in amount used in the diet, it also is less oxidative and theoretically results in less corrosiveness. Therefore, the purpose of our trials were to test levels and source of copper as a growth promoter in swine diets.

Procedures

In Experiment 1, 1,100 pigs (initially 74.2 lb) were allotted to one of five dietary treatments with eight replications per treatment (four per gender). Pigs were fed four corn-soybean diets according to a feed budget. Treatment diets consisted of a control diet with no added copper, three diets with 50, 100, and 200 ppm (parts per million) of added copper from copper chloride and a single diet with 200 ppm of copper from copper sulfate. In Experiment 2, 1,177 gilts (initially 68.9 lb) were allotted to one of seven dietary treatments in a randomized complete block design with six pens per treatment. Diets were provided in two phases from d 0 to 27 and day 27 to 56. Diets consisted of a control diet with no added copper or the control plus 50, 100, or 200 ppm of added copper from either copper chloride of copper sulfate.

Results and Discussion

In the first experiment, adding copper sulfate to the diet increased (P<.003) ADG and improved F/G (P < .001) for the overall experiment, while ADFI was decreased (P<.05) compared to the control diet. Copper chloride tended to linearly improve (P<.07) ADG and improved F/G (P<.05). The greatest response was found during the first phase (day 0 to 31) of the experiment.

For the second experiment, pigs fed either copper source had greater (P<.01) ADG during the first two weeks of the experiment compared to pigs fed the control diet (Table 1). There were no differences between copper sources and no response to copper level indicating that the maximal response was achieved with the first 50 ppm of both copper sources. Adding copper sulfate to the diet also reduced (P<.03) ADFI and copper chloride tended to improve (P<.07) feed efficiency from day 0 to 14.

Although there were minor differences between copper sources during the remainder of the trial, there were no further advantages of adding either copper source compared to the control diet. For the overall experiment, ADG was greater (P<.05) for pigs fed copper sulfate compared to those fed the control diet. They also tended to have greater (P<.08) ADG than pigs fed the diets containing copper chloride. Pigs fed diets containing copper sulfate had greater (P<.02) ADFI than pigs fed copper chloride; however, neither source influenced ADFI when compared to pigs fed the control diet. Also, neither copper source influenced F/G compared to pigs fed the control diet; however, there was a level by source interaction (P<.05). The reason for the interaction is that F/G improved with increasing levels of copper chloride while no distinct pattern was found with increasing level of copper sulfate.

In conclusion, adding low levels of copper (50 to 100 ppm) to diets during the first two to four weeks of the growing-finishing phase appears to provide an advantage in gain and feed efficiency. Because of the low cost of copper and improvements in ADG and feed efficiency, this practice may offer an economic benefit for the producer. Using low copper levels in only the first grow-finish diet also minimizes copper excretion. Adding copper during the late finishing phase does not appear to provide any significant advantage in gain or feed conversion.

Table 1. Growth Performance of Pigs Fed Increasing Copper Chloride ppm or Copper Sulfate ppm (Exp. 2)[a]

	Control	Copper Chloride			Copper Sulfate			
Item	No Cu	50	100	200	50	100	200	SEM
Phase I, d 0 to 14								
ADG, lb[bc]	1.83	2.00	1.91	2.04	2.01	1.99	2.02	.04
ADFI, lb[b]	3.29	3.42	3.39	3.35	3.48	3.41	3.53	.07
F/G[d]	1.80	1.72	1.78	1.65	1.73	1.71	1.75	.04
Overall, d 0 to 56								
ADG, lb[e]	1.90	1.90	1.91	1.95	1.96	1.93	1.96	.02
ADFI, lb[f]	4.16	4.16	4.13	4.16	4.21	4.23	4.26	.04
F/G[g]	2.19	2.19	2.17	2.14	2.15	2.19	2.17	.02

[a] A total of 1,176 gilts with an average initial wt of 69 lbs were used in the experiment. The values represent the means of six pens per treatment and 28 pigs per pen.

[b]control versus copper sulfate, P<.05.

[cd]control versus copper chloride, P<.01 and .07

[ef]Copper chloride versus copper sulfate, P<.10 and .02

[g]copper source x level interaction, P<.05

COOPERATIVE EXTENSION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
KANSAS STATE UNIVERSITY
MANHATTAN, KS 66506-3403

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

SWINE UPDATE

Swine Day

November 15
Holidome—Manhattan

Jim L. Nelssen
Extension Specialist
Swine

Robert D. Goodband
Extension Specialist
Swine

Mike D. Tokach
Extension Specialist
Swine

Steve Dritz
Swine Specialist
Food Animal Health and
Management Center

Kansas State University
Cooperative Extension Service
Department of Animal Sciences & Industry
Weber Hall, Room 213
Kansas State University
Manhattan, Kansas 66506