Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 1152

2007

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EFFECT OF HUMIDITY ON FLOW ABILITY OF SPECIALTY PROTEIN SOURCES IN NURSERY DIETS

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Summary

We conducted an experiment to determine the effects of humidity on angle of repose (flowabilty) of different specialty protein sources. Five specialty proteins sources were used: fish meal, powdered blood meal (AP301), granulated blood meal (AP301G), powdered spray-dried animal plasma (AP920), and granulated spray-dried animal plasma (Appetein). The specialty protein sources were added at 0, 2.5, 5, 7.5, and 10% to a 70:30 corn-soybean meal blend. The experiment was conducted in an environmentally controlled nursery to minimize temperature and humidity fluctuations. There were two relative humidity levels, 34 and 64%. All samples were placed in the barn 24 h before the experiment was conducted to allow acclimation to the conditions. Flow ability was then determined by measuring angle of repose. Angle of repose is the maximum angle in which a pile of ingredient retains its slope. A large angle of repose represents a steeper slope and poorer flow ability. There was a protein source × inclusion level × humidity interaction observed ($P<0.01$). Humidity increased angle of repose, decreasing flow ability. Angle of repose increased with increasing inclusions of powdered animal plasma and fish meal, resulting in poorer flow ability. Powdered blood cells did not affect angle of repose with increasing inclusion levels. Angle of repose decreased as granular animal plasma and blood cell inclusions increased, improving flow ability. In conclusion, specialty protein ingredients in powder form reduce flow ability, while granulated specialty protein sources improve flow ability.

(Key words: feed manufacturing, angle of repose, humidity.)

Introduction

Specialty protein sources are often included in nursery pig diets to stimulate feed intake and improve growth performance. High concentrations of these ingredients, unless pelleted, frequently increase the incidence of bridging in bins and feeders. If these ingredients would flow easier in a meal diet, it would give producers and nutritionists more options in diet formulation. It would also mean fewer "out of feed" occurrences. Quantifying the differences in flow ability among different ingredients could also justify the selection of one ingredient over another. Previous research confirms that specialty ingredients influence the flow ability of nursery diets. Previous data also demonstrated that granular specialty protein sources improve flow ability

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compared with powdered products. Specialty protein sources in powder form decrease flow ability. However, these prior research trials were conducted in a laboratory environment and not under typical nursery barn conditions. Humidity is one factor that could contribute to feed handling issues. The increase in humidity in a barn could result in an increase in water absorbed by specialty ingredients included in the diet and cause an increase in feed bridging and handling issues. Therefore, the objective of the study was to evaluate the effects of humidity on angle of repose (a measure of flow ability) of different specialty protein sources.

Procedures

Five specialty proteins sources were used: fish meal, powdered blood meal (AP301), granulated blood meal (AP301G), powdered spray-dried animal plasma (AP920), and granulated spray-dried animal plasma (Appetein). The specialty protein sources were added at 0, 2.5, 5, 7.5, and 10% to a 70:30 corn-soybean meal blend.

This experiment was conducted in an environmentally controlled nursery to minimize temperature and humidity fluctuations. The experiment was conducted at two relative humidity levels of 34 and 64%. All samples were placed into the environmentally controlled nursery 24 h before the experiment was conducted to allow acclimation of the ingredients to the environmental conditions. Temperature was held constant at 90°F. Temperature and humidity were monitored throughout the acclimation period. Six digital humidity and temperature recorders were placed in the nursery to measure minimum and maximum temperature and humidity. Flow ability was determined by measuring angle of repose. Angle of repose was replicated three times with each sample.

Angle of repose is defined as the maximum angle measured in degrees at which a pile of grain retains its slope. An angle of repose tester was constructed from four pieces of poly vinyl chloride (PVC). The tester was 3" in diameter and 36" tall and attached to a 3" PVC floor mounting. A 3" diameter plate was mounted to the top of the machine, which allowed two 3" PVC couplers to slide up and down the long axis of the tester. To conduct the angle of repose test, a 500 g sample was placed inside the couplers at a specified height at the top of the tester. The base of the angle of repose tester was held stationary and the PVC couplers were lifted vertically, allowing the test ingredient to flow downward resulting in a pile on top of the plate. The height of the pile was measured and angle of repose was calculated by the following equation: angle of repose = $\tan^{-1}$ (the height of the pile divided by one half the diameter of the plate). A larger angle of repose represents a steeper slope and poorly flowing product; a low angle of repose represents a freer flowing product.

All data was analyzed using PROC MIXED in SAS 8.1. Ingredient source and inclusion level were modeled and parameter estimates were then obtained to develop regression equations. A graph showing the modeled data was generated.

Results and Discussion

There was a protein source × inclusion level × humidity interaction observed (Figure 1, $P<0.01$). Spray-dried animal plasma in powder form increased angle of repose as inclusion level increased, decreasing flow ability. There was little to no increase in angle of repose with increasing powdered spray-dried blood cells. The granulated spray-dried blood cells and animal plasma decreased angle of repose, improving flow ability compared with the powdered ingredients. Increasing the inclusion level of fish meal resulted in an increase in angle of repose, decreasing flow ability. This response was not expected since previous research demonstrated no change in angle of repose with increasing inclusions of

fish meal. Although the source was the same as our previous research, the fish meal used in this experiment may have had smaller particle size or been more hydroscopic than fish meal used previously. As relative humidity was increased from 34 to 64%, angle of repose increased (poorer flow ability) for all ingredients. All ingredients followed the same trends at both humidity levels.

These data confirm that humidity, ingredient inclusion percentage, and ingredient form (powder or granulated) will affect flow ability of diets fed in meal form. Humidity increased angle of repose, which decreased flow ability of meal diets. Specialty protein ingredients in powder form reduce flow ability, although granulated specialty protein sources improve flow ability.

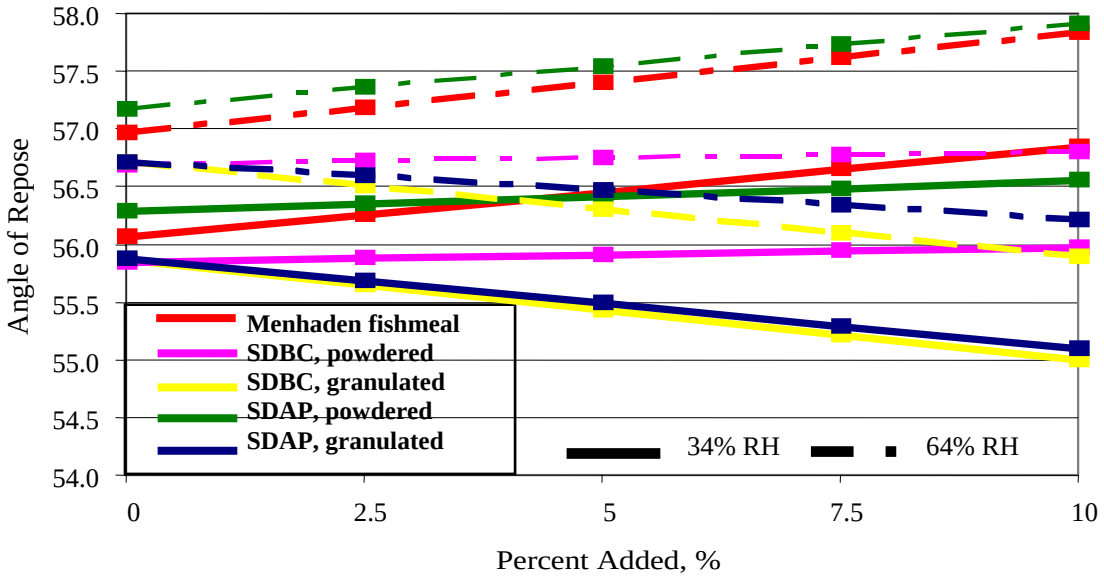

Figure 1. There was a specialty protein source × inclusion level × humidity interaction ($P<0.01$). Angle of repose increased with increasing inclusions of powdered animal plasma and fish meal, resulting in poorer flow ability. Powdered blood cells did not affect angle of repose with increasing inclusion levels. Angle of repose decreased as granular animal plasma and blood cell inclusions increased, improving flow ability. Humidity increased angle of repose, decreasing flow ability.