LACTOSE AND SPECIALTY PROTEIN SOURCES INFLUENCE FLOW ABILITY OF NURSERY PIG DIETS

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Summary

Two experiments were conducted to determine the effects of lactose products and specialty protein sources on feed flow ability as measured by 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. A 70:30 corn-soybean meal blend served as the base to which all specialty ingredients were added. In Experiment 1, six lactose sources were evaluated. Three sources were fine, powdered whey permeates, and the other sources were coarse-ground whey permeate, edible-grade spray-dried whey, and a crystalline lactose source. Lactose sources were added at 0, 5, 10, 20, and 30% to the corn-soybean meal blend. Angle of repose was then measured on these mixtures, as well as on the individual lactose sources. There was a lactose source × level interaction ($P<0.0001$) observed. Increasing lactose source decreased angle of repose, but the coarse whey permeate had a much greater improvement in flow ability, resulting in the interaction. In Experiment 2, five specialty protein sources were evaluated: powdered or granulated spray-dried animal plasma, powdered or granulated spray-dried blood cells, and select menhaden fish meal. Specialty protein sources were added at 0, 2.5, 5, 7.5, and 10% to the 70:30 corn-soybean meal blend. There was a specialty protein source × level interaction ($P<0.0001$) observed. As powdered animal plasma and blood cells increased, angle of repose increased, resulting in poorer flow ability. With the addition of granulated animal plasma and blood cells, angle of repose decreased, indicating better flow ability. Increasing fish meal did not influence angle of repose. These data confirm that greater flow ability is observed with granulated specialty protein or coarsely ground lactose sources.

(Key Words: Angle of Repose, Lactose, Flow Ability, Specialty Protein Sources.)

Introduction

Lactose and 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 feed bridging in bins and feeders. Therefore, two experiments were conducted to determine the effects of different lactose sources and specialty protein sources on flow characteristics of a 70:30 corn-soybean meal diet.

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Procedures

In Experiment 1, the objective was to evaluate the effects of increasing lactose sources on diet flow ability. Six different lactose sources were used, including three sources of fine, powdered whey permeates; a coarse-ground whey permeate, an edible-grade spray-dried whey; and crystalline lactose. The lactose sources were added at 0, 5, 10, 20, and 30% of a 70:30 corn-soybean meal blend. In Experiment 2, the objective was to evaluate the effects of increasing specialty protein sources on flow ability. The five different protein sources were powdered or granulated spray-dried animal plasma, powdered or granulated spray-dried blood cells, and select menhaden fish meal. The specialty protein sources were added at 0, 2.5, 5, 7.5, and 10% to a 70:30 corn-soybean meal blend.

The corn and soybean meal were dried for 12 h to equalize moisture content. After mixing the test ingredient with the corn:soy blend, angle of repose was measured. Angle of repose was replicated five times within 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 4 pieces of poly vinyl chloride (PVC). The tester is 3 inches in diameter and 36 inches tall and attached to a 3 inch PVC floor mounting. A 3-inch-diameter plate was mounted to the top of the machine, which allowed two 3-inch 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 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 would represent a freer flowing product. All data was analyzed by using PROC MIXED in SAS 8.1. Source and concentration were modeled, and parameter estimates were then calculated to develop regression equations. Graphs showing the modeled data were generated.

Results and Discussion

In Experiment 1, a lactose source × concentration interaction ($P<0.0001$) was observed. As percentage of all lactose sources increased, angle of repose decreased, indicating improved flow ability. The coarse-ground lactose source had the greatest decrease in angle of repose as the inclusion rates increased, therefore, having the best flow ability and resulting in the interaction. The improvement in flow ability observed with the additions of fine lactose sources is not consistent with the normal observations of poor flow ability of milk products in swine diets, Humidity and overall environment of commercial barns may play a large role in the flow ability of lactose sources. In our trial, the corn:soybean meal blend was standardized to a low moisture content, More research is needed to determine the effects of additional factors, such as humidity, on the flow ability of lactose sources.

In Experiment 2, a specialty protein source × concentration interaction ($P<0.0001$) was observed. Angle of repose increased with increasing inclusions of powdered animal plasma and blood cells, indicating poorer flow ability. The angle of repose decreased as inclusion rates of granulated animal plasma and blood cells increased, indicating better flow ability. Increasing fish meal did not influence angle of repose.

These data confirm that specialty ingredients influence the flow ability of starter diets when fed as meal. Specialty protein and lactose sources in powder form reduce flow ability in meal diets, whereas granulated specialty protein sources and course-ground lactose sources improve flow ability.

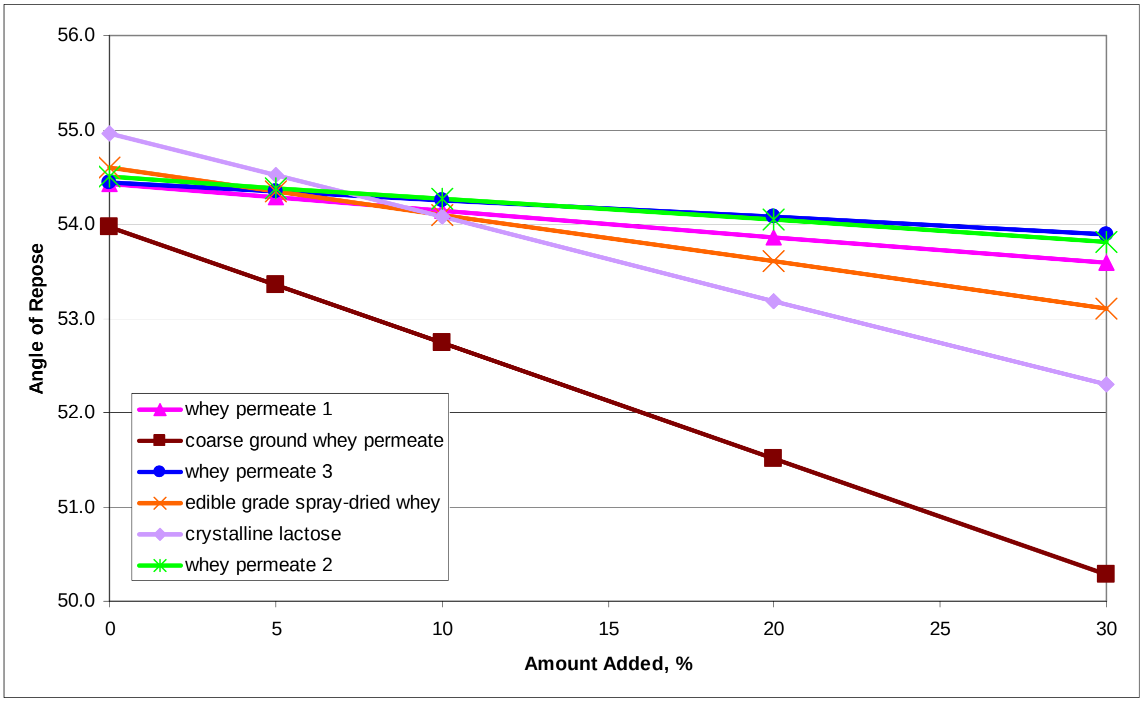

Figure 1. Effect of Lactose Sources on Flow Ability. There was a lactose source × concentration interaction ($P<0.0001$). As percentage of all lactose sources increased, angle of repose decreased, therefore improving flow ability. The coarse-ground lactose source had the greatest decrease in angle of repose as the inclusion rates increased, therefore having the best flow ability and resulting in the interaction observed.

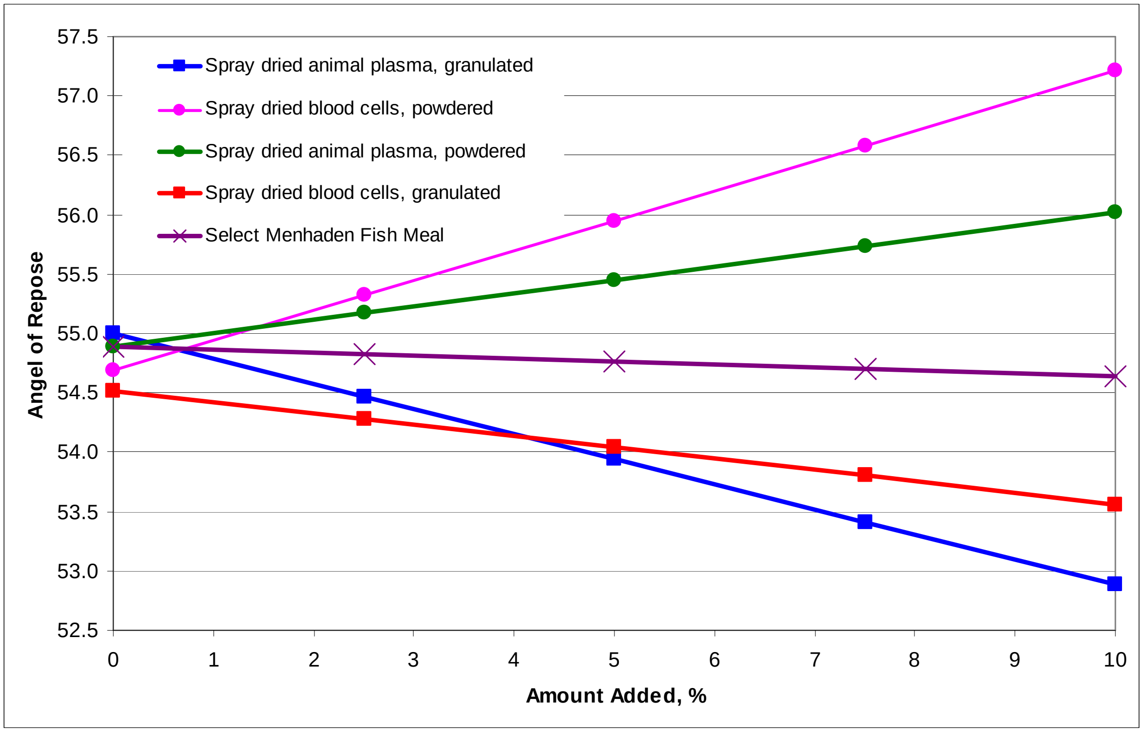

Figure 2. Effect of Specialty Protein Sources on Flow Ability. A specialty protein source × concentration interaction ($P<0.0001$). Angle of repose increased with increasing inclusions of powdered animal plasma and blood cells, therefore resulting in poorer flow ability. The angle of repose decreased as granulated animal plasma and blood cells inclusions increased, therefore resulting in a better flow ability. Increasing fish meal did not influence angle of repose.