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EFFECT OF GLYCEROL ON FLOW ABILITY OF SWINE DIETS

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Summary

We conducted two experiments to determine the effect of added glycerol or a 50:50 soy oil/glycerol blend on the flow ability characteristics of ground corn or ground corn and 15 or 30% spray-dried whey. Experiments were conducted using corn ground by either a full circle, tear drop hammer mill or a three-high roller mill at the Kansas State University Grain Science Feed Mill. Flow ability was determined by measuring angle of repose. In Exp. 1 we evaluated the effects of added soy oil, glycerol, or a 50:50 soy oil/glycerol blend on the flow ability of ground corn. Samples were ground through a roller mill (RM) or hammermill (HM). Particle size mean and standard deviations of the ground corn were 645 microns and 1.97 for the roller mill and 674 microns and 2.31 for the hammer mill. Soy oil, glycerol, or a 50:50 blend of soy oil/glycerol was added to the ground corn at 0, 2, 4, 6, or 8% for a total of 30 samples (1 RM sample, 1 HM sample, 3 liquid sources, and 5 levels of added liquid). In Exp. 2, we evaluated the effects of added soy oil, glycerol, or a 50:50 soy oil/glycerol blend on the flow ability of 85:15 or 70:30 blend of HM ground corn and spray-dried whey. Soy oil, glycerol, or a 50:50 blend of soy oil/glycerol was added to the ground corn and spray-dried whey-based diets at 0, 4, or 8% for a total of 18 samples (1 HM sample, 2 levels of added whey, 3 liquid sources, and 3 levels of added liquid). Angle of repose was then measured, and replicated 4 times on each sample. In Exp. 1 there was a three way interaction ($P<0.05$) between mill type, liquid source, and percent liquid added. Roller mill ground grain had decreased angle of repose (better flow ability) compared to HM ground grain. The addition of soy oil increased angle of repose, decreasing flow ability. The addition of glycerol or a 50:50 soy oil/glycerol blend decreased angle of repose, improving flow ability with HM ground corn. Addition of glycerol did not influence flow ability when added to RM corn ground. In Exp. 2 there was a three way interaction ($P<0.05$) between spray-dried whey level, added liquid source, and percent of liquid added. The addition of glycerol or the 50:50 soy oil/glycerol blend decreased angle of repose, improving flow ability. The addition of glycerol decreased angle of repose greater in the 15% spray-dried whey sample compared to the 30% spray-dried whey sample. The addition of soy oil increased angle of repose regardless of spray-dried whey concentration. These data suggest that the addition of glycerol to a meal diet containing HM ground corn will improve flow ability.

(Key words: feed manufacturing, glycerol, flow ability.)

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Introduction

Decreasing particle size and adding fat sources, such as soy oil or choice white grease to a swine diet, can improve pig performance and profitability. Limits to reducing particle size and the amount of added fat are based on the ability of the feed to flow through feed handling systems and feeders. Previous research has demonstrated that grain ground with a roller mill (RM) had improved flow ability compared to grain ground with a hammermill (HM). These data also demonstrate that decreasing particle size and adding increasing levels of fat to a diet will decrease flow ability and increase feed handling problems. Glycerol is currently being evaluated for use as a feed ingredient in swine diets. The influence of glycerol on feed flow ability is not known. Therefore, the objective of our study was to evaluate the effects of added glycerol or a 50:50 soy oil/glycerol blend to the flow ability of ground corn or a ground corn diet with either 15 or 30% spray-dried whey.

Procedures

Experiments were conducted using corn ground by either a full circle, tear drop hammer mill or a three-high roller mill at the Kansas State University Grain Science Feed Mill. The corn contained 10.1% CP and 3.1% fat on an as-fed basis. Particle size and standard deviation were determined with a Ro-Tap tester with a stack of 13 screens, as outlined in the American Society of Agricultural Engineers (publication S319). Angle of repose was 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" 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 would represent a freer flowing product. All data was analyzed using PROC MIXED in SAS 8.1.

Experiment 1. The objective was to evaluate the effects of added soy oil, glycerol, or a 50:50 soy oil/glycerol blend on the flow ability of ground corn. Samples were ground through a roller mill or hammermill. Particle size mean and standard deviations were 645 microns and 1.97 for corn ground through the roller mill and 674 microns and 2.31 for corn ground through the hammer mill. Soy oil, glycerol, or a 50:50 blend of soy oil/glycerol was added to the ground corn at 0, 2, 4, 6, or 8% for a total of 30 samples (1 RM sample, 1 HM sample, 3 liquid sources, and 5 levels of added liquid). Angle of repose was then measured, and replicated 4 times on each sample.

Experiment 2. The objective was to evaluate the effects of added soy oil, glycerol, or a 50:50 soy oil/glycerol blend on the flow ability of a HM ground corn diet with either 15 or 30% spray-dried whey. The HM sample used in Exp.1 was the same corn sample used in Exp. 2. Soy oil, glycerol, or a 50:50 blend of soy oil/glycerol was added to the ground corn and spray-dried whey-based diet at 0, 4, or 8% for a total of 18 samples (1 HM sample, 2 levels of added whey, 3 liquid sources, and 3 levels of added liquid). Angle of repose was then measured and replicated 4 times on each sample.

Results and Discussion

Experiment 1. There was a three way interaction ($P<0.05$) between mill type, fat source, and percent fat source added (Figure 1). Roller mill ground grain had decreased angle of repose (better flow ability) compared to HM ground grain. The addition of soy oil increased angle of repose, decreasing flow ability.

The addition of glycerol or a 50:50 soy oil/glycerol blend decreased angle of repose, improving flow ability when added to the diet containing HM ground corn. Adding glycerol or the 50:50 soy oil/glycerol blend to the diet containing RM ground corn did not influence angle of repose.

Experiment 2. There was a three way interaction ($P<0.05$) between spray-dried whey level, added liquid source, and percent of liquid added (Figure 2). The addition of glycerol or the 50:50 soy oil/glycerol blend decreased angle of repose, improving flow ability. The addition of glycerol decreased angle of repose greater in the 15% spray-dried whey sample compared with the 30% spray-dried whey sample. The addition of soy oil increased angle of repose regardless of spray-dried whey concentration.

These data suggest that the addition of glycerol to a meal diet will improve flow ability. The addition of glycerol to a HM ground diet will improve flow ability more than when added to RM ground corn. This could be the result of glycerol interacting with the smaller particles due to the increased standard deviation of the HM ground grain. The addition of a 50:50 soy oil/glycerol blend will also improve flow ability of a corn-based diet compared to the addition of soy oil. These data also suggest that glycerol will improve the flow ability of diets with added spray-dried whey. Our experiments suggest that flow ability of feed will be improved by the addition of glycerol, especially when added to diets containing corn ground through a hammer mill.

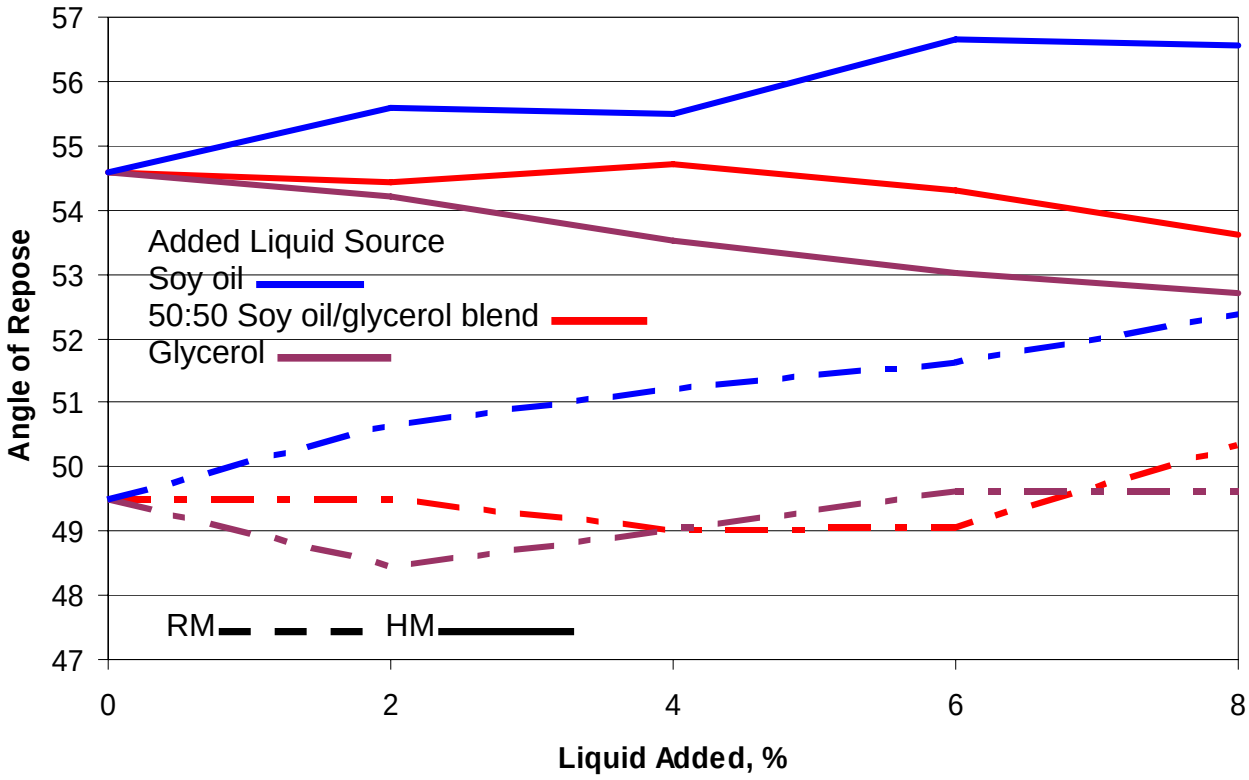

Figure 1. Influence of Corn Ground Through a Hammer (HM) or Roller (RM) Mill, Liquid Source, and Liquid Level on Angle of Repose (Mill type × liquid source × percent liquid interaction (*P*<0.05).

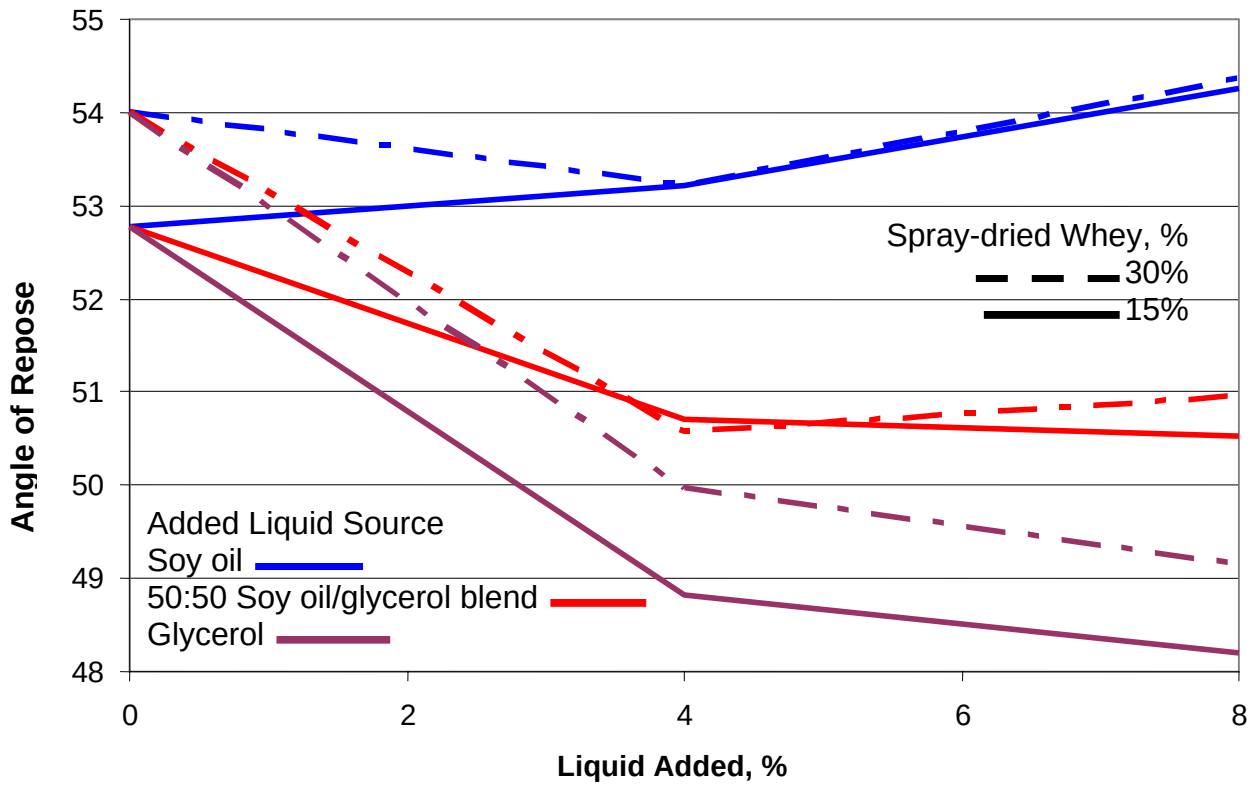

Figure 2. Influence of Spray-dried Whey Level, Liquid Source, and Percent Liquid Added on Angle of Repose (Spray-dried whey level × liquid source, × percent liquid interaction, *P*<0.05).