Molasses/Fat Combination as a Nutrient Source for Swine

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Liquid molasses and fat have been fed in combination successfully as liquid supplements to cattle for decades. Dr. Wayne Perry at Purdue University was a pioneer in developing and evaluating such products for beef cattle. Liquid molasses has been used intermittently and sparingly in the swine industry as an energy source for more than a century. Molasses continues to be fed to swine in Cuba, Mexico, Venezuela, Philippines, and other geographic areas where sugar cane is grown and processed. Sugar cane typically yields a unit of molasses for each two units of processed sugar (sucrose). Molasses is a mixture of monosaccharides and disaccharides, rich in minerals, but nearly devoid of protein and vitamins. Molasses has a reputation as an appetite enhancer for both swine and cattle. The limitation on the use of liquid molasses in complete feeds is the reduced energy content of an ingredient that typically contains more than 50% water. The addition of simple liquid molasses reduces feed efficiency, as the energy density of the diet is reduced. Efforts to provide liquid molasses in a free choice feeding system for swine have been fraught with management problems, including sanitation, flies, wet conditions, humid environment, and laxative activity.

Fat has been combined with molasses to greatly increase the energy density of the resulting ingredient. In addition, the combination of molasses and liquid fat offers physical advantages, including dust control, acidification of the final diet, and superior flow characteristics over molasses alone.

Experimental Design

The present study was designed to determine the metabolizable energy (ME) of the Molasses/Fat combination and to evaluate the product in a growing-finishing swine study.

Metabolizable Energy Study

The initial study was a basic study done with ducks to obtain an accurate estimate of ME of the Molasses/Fat combination. In the duck model study, test ingredients were force-fed in a single meal via tygon tubing to assure accurate intake values. All excreta were caught in attached plastic bags to minimize waste. A comparably treated fasted group provided estimates of exogenous losses, which were used to correct and calculate ME in the test ingredients. Energy content of all test materials was determined by bomb calorimetry using an adiabatic calorimeter. The treatments consisted of (1) Fasted; (2) Corn Starch; and (3) Molasses/Fat Product. In this manner, the ME in the Molasses/Fat combination is compared to a highly chemically defined product, starch.

Growth Study

In the growth trial, 144 pigs, consisting of 72 barrows and 72 gilts weighing an average of 55 lb, were allotted by litter outcome groups to four treatments, with six pigs per pen and six replications per treatment. Gilts and barrows were allotted separately to allow diet shifting, and analysis for feed intake

and feed efficiency by sex. Individual pens were shifted from grower to finisher rations when the pen mean attained 114 lb. Pigs were removed for carcass analysis as they attained 246 lb body weight.

The four treatments were as follows:

1. Basal Diet containing 10% corn starch;
2. Basal Diet containing 10% Molasses/Fat combination;
3. Diet 1 with .17% Lysine HCl added; and
4. Diet 2 with .17% Lysine HCl added.

The experimental diets are shown in Table 1.

Results

Table 2 shows the True ME adjusted for protein digestion (TMEn) values expressed on a dry matter basis. As expected, the Molasses/Fat combination has very high ME values on a dry matter basis as compared to corn starch (5.91 vs. 4.10 kcal/g). However, when calculated on an as-fed basis, which includes the water in the product, the Molasses/Fat combination has less ME than corn starch (3.19 vs. 3.66 kcal/g). The ME value for Molasses/Fat compares closely to a predicted value based on the chemical composition of the product:

	% of Product	Theoretical kcal/g	Total kcal/g
Fat	20	9	1.80
Water	46	0	0
Molasses Sugar	34	4	1.36
	100		3.16

Expressed in another manner, the TMEn of Molasses/Fat combination as a percent of corn starch compares as follows:

TMEn of Molasses/Fat as a % of Corn Starch	
Dry matter basis	As fed basis
144 %	87.2 %

ME values in the feed industry are often expressed as starch replacement values. This is done recognizing that corn starch is one of the most chemically well defined ingredients available for use in research studies and it contains little other than starch, with a consistent energy value within a species of animal. Therefore, an accurate value to be used with swine diets would be to express the comparative percent of Molasses/Fat to corn starch and multiply that figure by the composite energy value assigned to corn starch in the new 1998 NRC publication for swine nutrition. The composite value in the new NRC for corn starch is 3.98 kcal/g. Multiplying that figure by 87.2% gives a value for Molasses/Fat combination of 3.47 kcal/g. This is the figure that should be used in a computer matrix or hand calculation when this Molasses/Fat combination is used. The number is almost identical to the energy value assigned to corn, which is 3.42 kcal/g.

Performance data of pigs fed the Molasses/Fat product is shown in Table 3. Daily gain was significantly greater (P<.05) for the pigs receiving Molasses/Fat product during the growth phase and for the entire growing-finishing period. Gain:Feed values were not significantly different (P>.05) during either the growing or the finishing phase of the study, although the numerical values were greater for the pigs receiving the diet without the Molasses/Fat product. Daily feed intake was significantly increased (P<.05) for pigs receiving the Molasses/Fat product throughout the study. Carcass data were collected on swine as they attained 246 lb finishing weight. There were no significant treatment differences for loin eye area, backfat, fat free lean index or carcass yield.

The additional lysine did not significantly influence any performance or carcass criteria. The 0.90% lysine in the grower diets and the 0.71% lysine in the finisher diets were adequate for these pigs.

Figure 1 shows the uniform increase in feed intake of pigs receiving the Molasses/Fat combination. With the extremely similar metabolizable energy of all four diets, the intake data support the flavor or appetite enhancing benefits attributed to molasses in swine diets. Table 4 demonstrates that the increased feed intake by pigs receiving the Molasses/Fat product, which was almost one-half pound per pig per day, was sufficient to more than compensate for the difference in dry matter, such that the pigs on the Molasses/Fat product consumed 0.25 lb more dry matter than did the control pigs.

Applications

Molasses/Fat combination, a liquid product with approximately 80% liquid molasses and 20% fat, can be incorporated into swine rations up to 10% of the diet without creating difficulty in flow characteristics.

The use of Molasses/Fat combination provides an ingredient to enhance feed intake and increase daily gain and the through-put of a building.

This product has metabolizable energy value comparable to corn on an “as fed” basis (e.g., containing 46% water).

The Molasses/Fat product may have special value when included in diets that tend to be limited in palatability, whether that be extremely dry ingredients, end of season ingredients or ingredients that are inherently low in palatability.

For computer formulation using National Research Council Nutrient values and ingredients standards, it is recommended that a ME value of 3.47 kcal/g be assigned to the Molasses/Fat combination.

Table 1. Experimental diets.

Growth Phase, 55 to 114 lb	Experimental Diet			
	1	2	3	4
Corn	64.0	64.0	63.83	63.83
Dehulled Soybean Meal	23.0	23.0	23.0	23.0
Starch*	10.0	-	10.0	-
Molasses Based Liquid Supplement	-	10.0	-	10.0
Lysine HCl	-	-	.17	.17
Vit & Min	3.0	3.0	3.0	3.0
Protein %	16.3	16.3	16.48	16.48
Lysine %	.90	.90	1.04	1.04
Kcal/g	3.22	3.18	3.22	3.17
Lysine/Kcal ME, g	2.79	2.82	3.22	3.27

Finisher Phase, 114 to 246 lb	Experimental Diet			
	1	2	3	4
Corn	70.3	70.3	70.18	70.18
Dehulled Soybean Meal	16.7	16.7	16.7	16.7
Starch*	10.0	-	10.0	-
Molasses Based Liquid Supplement	-	10.0	-	10.0
Lysine HCl	-	-	.17	.17
Vit & Min	3.0	3.0	3.0	3.0
Protein %	14.6	14.6	14.75	14.75
Lysine %	.71	.71	.86	.86
Kcal/g	3.24	3.20	3.24	3.19
Lysine/Kcal, g	2.18	2.21	2.65	2.69

*8.72% starch equivalent to 10% molasses/fat.
Remaining 1.28% starch provides dietary isocaloric filler.

Table 2. Summary of Molasses/Fat metabolism study.

	Corn Starch	Molasses/Fat
TMEn[1] kcal/g, DM basis	4.10	5.91
Dry Matter, %	89.40	54.09
TMEn[1] kcal/g, as fed	3.66	3.19

[1]True Metabolizable Energy adjusted for protein utilization.

Table 3. Performance of pigs fed diets with and without Molasses/Fat product.

Molasses/Fat Product %	0	0	10	10
Lysine HCl %	0	0.17	0	0.17
Daily Gain, lb				
Grower*	1.61	1.61	1.67	1.76
Finisher	1.96	1.99	2.03	2.06
Total*	1.81	1.83	1.88	1.94
Gain:Feed				
Grower	0.453	0.462	0.437	0.448
Finisher	0.329	0.328	0.306	0.312
Total	0.366	0.365	0.344	0.352
Daily Feed Intake, lb				
Grower*	3.51	3.39	3.83	3.95
Finisher*	5.97	6.29	6.63	6.62
Total*	4.97	5.08	5.47	5.51
Loin Eye Area, sq in	6.5	6.8	6.5	6.6
Backfat, in	0.9	0.9	0.96	0.95
Fat Free Lean Index[1]	49.9	49.5	49.5	49.7
Carcass Yield, %	75.5	75.2	75	74.7

*Significant effect of molasses/fat vs. corn starch on performance.

[1] Fat Free Lean Index: 2.69 + .4465 x hcwt (lb) +.933x loin muscle depth (in) - 17.54 x fat depth in percent lean = lb FFL/hcwt

Table 4. Nutrient intake.

	Daily Feed Intake, lb	Dry Matter % of Diet	Dry Matter Intake, lb
Cornstarch Diet	3.45	88.15	3.04
Molasses/Fat Diet	3.89	84.50	3.29

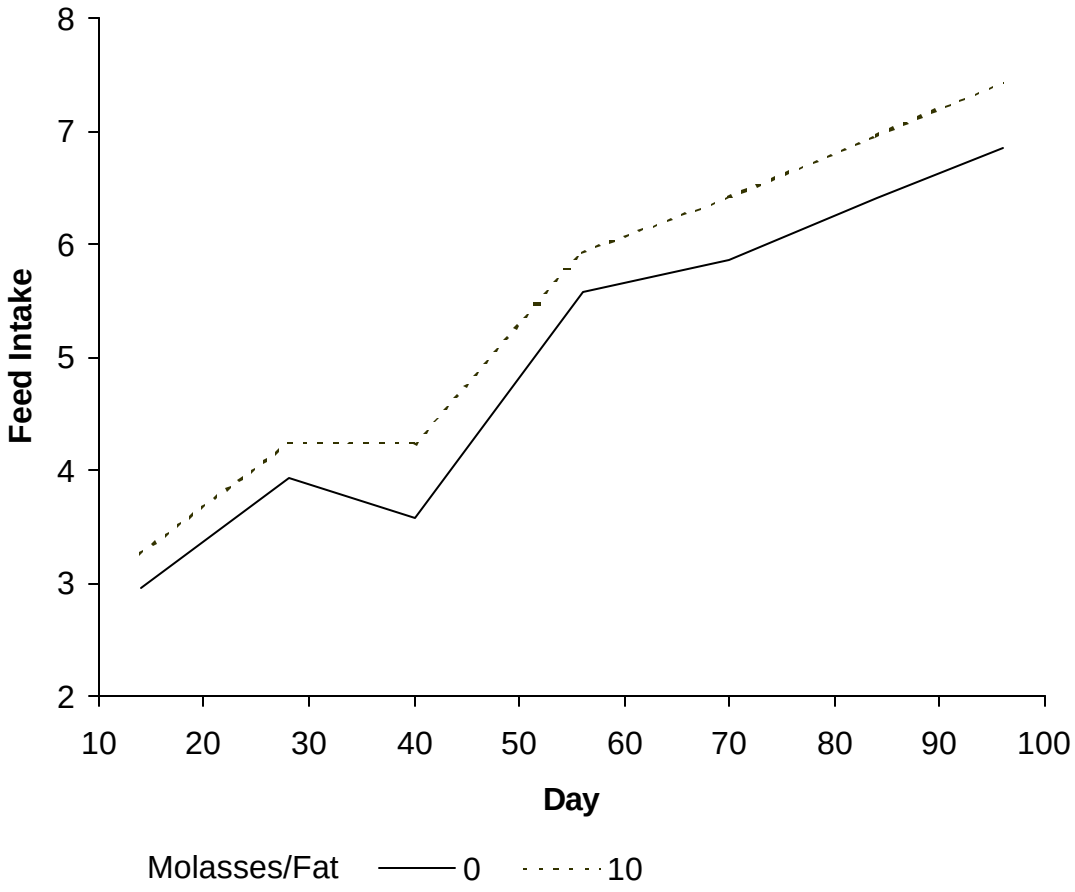

Figure 1. Feed intake over time.