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W H. Turlington

G L. Allee

Jim L. Nelssen

EFFECTS OF MILK PRODUCTS (CASEIN AND LACTOSE)[a] ON NUTRIENT DIGESTIBILITY IN WEANED PIGS FED A HIGH FAT DRY DIET

W. H. Turlington, G. L. Allee, and J. L. Nelssen

Summary

Two trials using a total of 48 pigs were conducted to compare protein (soybean meal and casein) and carbohydrate (dextrose and lactose) sources. In trial 1, digestion studies were conducted to determine apparent digestible energy content of the four treatments and apparent nutrient digestibility coefficients. In trial 2, pigs were sacrificed to determine ileal and total tract (apparent) nutrient digestibility coefficients. Results suggest that milk products are important to improving energy and nutrient digestibility in the young pig. The younger the pig or the sooner after weaning, the greater the benefit from their addition. The data also suggest that milk protein is of greater value in improving nutrient utilization than milk carbohydrate.

Introduction

Prior to weaning, pigs consume a highly digestible, high fat, high lactose diet in the form of sow's milk. At weaning, pigs are commonly fed a high starch, low fat, low lactose, dry diet. Milk products have been shown to improve the performance of weaned pigs by increasing nutrient digestibility. Kansas State University has made a strong research program to evaluate protein and carbohydrate fractions derived from milk. Our objective in this experiment was to compare protein and carbohydrate sources derived from milk or plant origin.

Procedures

The experiment involved two trials using 24 pigs each. Pigs were individually housed in 2 ft x 2 ft stainless steel cages equipped with nipple waterers. Environmental temperature was maintained at 30-32 C. Pigs were randomly allotted across dietary treatments based on litter and initial weight. Experimental treatments were designed in a 2x2 factorial structure with two protein (PRO) sources (soybean meal (SBM) and casein (CAS) and two carbohydrate (CHO) sources (dextrose (DEX) and lactose (LAC)). Diet compositions are shown in Table 1. All treatments contained 10% soybean oil. Since many postweaning diets contain little added fat, these treatments were considered high fat diets. Diets were formulated to contain .809% lysine, .517% Ca and .453% P per 1000 kcal ME/lb. These concentrations are based on a diet with 1550 kcal ME/lb containing 1.25% lysine, .80% Ca, and .70% P.

[a]Casein and lactose provided by Merrick's Inc., Middletown, WI.

In trial 1, pigs were weaned at 17 days of age. After a 5-day adjustment period, a digestion study was conducted (period 1) using a 5-day total fecal collection. Pigs were fed .6 lb per day. After the collection period, pigs were reallotted across treatments with each receiving a different treatment. After a 5-day adustment, a second digestion study was conducted (period 2). The pigs were fed 1.0 lb per day. Because of excess feed wastage by pigs fed CAS, feed intake was used as covariate in statistical analysis for period 2. From the digestion studies, digestible energy (DE) content of the treatments and apparent nutrient digestbility coefficients (DC) were determined. Average initial weights of pigs for the digestion trials were 11.1 and 15.3 lb, respectively.

In trial 2, a group of 24 pigs was weaned at 17 days of age. Average initial weight of pigs was 6.8 lbs. Treatment allotment and housing were the same as described in trial 1. After a 5-day adjustment, .2% Co:EDTA (an internal marker) was mixed with the treatments and fed for 5 days. On day 5, pigs were sacrificed in order to collect ileal and colon samples. From these samples, ileal and total tract (apparent) nutrient digestibilities were determined.

Results

Apparent DE content of the four treatments and apparent nutrient DC for trial 1 are shown in table 2. For period 1, apparent DE content was lower ($P<.01$) for treatments containing SBM as the PRO source. DE content tended to be lower for treatments containing DEX as a CHO source. Apparent DC for dry matter (DM), crude protein (CP) and fat were lower ($P<.01$) for pigs fed SBM. Only fat digestibility was lower ($P<.05$) for pigs fed DEX. Total CHO digestibility was determined by difference and was similar among the four treatments during period 1.

For trial 1, apparent DE content and apparent nutrient DC were higher for period 2 than for period 1. Apparent DE was lower ($P<.04$) for treatments containing SBM as the PRO source and for treatments containing DEX as the CHO source. Apparent DM and CP digestibilities were lower ($P<.07$) for SBM-fed pigs than CAS-fed pigs. A PRO x CHO interaction ($P<.07$) was observed for fat digestibility. The DC was lower for SBM-fed pigs when DEX was used as a CHO source, whereas it was similar for CAS-fed pigs when DEX or LAC were used. Total CHO digestibility was similar among the four dietary treatments during period 2.

Ileal and apparent nutrient DC for trial 2 are shown in table 3. PRO × CHO interactions ($P<.06$) were observed for ileal DM and total CHO digestibilities. DC's were lower for SBM-fed pigs with DEX as a CHO source, whereas they were similar for CAS-fed pigs. Ileal CP and fat digestibilities were lower ($P<.06$) for pigs fed SBM as a PRO choice. Ileal CP digestibility was lower ($P<.02$) for pigs fed DEX as a CHO source.

For trial 2, apparent DM, CP and total CHO digestibilities encountered a PRO x CHO interaction ($P<.06$). DC were lower for SBM fed pigs with DEX as a CHO source, whereas they were similar for CAS-fed pigs with DEX or LAC as a CHO source. Apparent fat digestibility was quite variable and no statistical differences were observed.

Conclusions

The results from our experiment support the fact that milk products improve nutrient digestibility. From trial 1, apparent DE content is 5 to 10% lower when SBM rather than CAS is used as the major PRO source. Based on the two periods, the younger the pig or the sooner after weaning, the greater the reduction from SBM. Although the effect was less, treatments containing DEX as a CHO source had lower DE content. Apparent nutrient DC's were also lower when SBM was used rather than CAS. This indicates that milk protein plays a major role in improving nutrient digestibility. Although comparison of DEX and LAC yielded only few differences, the CHO fraction may account for some of the differences measured for the PRO source. The SBM treatments had a greater portion of their carbohydrates coming from SBM, which is less readily available to the pig relative to DEX or LAC. These carbohydrates may play a role in limiting the availability of the SBM proteins.

Comparison of trials 1 and 2 stresses that smaller pigs have lower nutrient digestibilities and that milk products such as CAS and LAC are important to improving pig peformance. Since digestion in the lower digestive tract (colon) is of little benefit to the young pig, ileal digestibility should be a better indication of true nutrient digestibility. Thus, ileal nutrient digestibility coefficients demonstrate the improvements in nutrient utilization by the young pig when milk products were incorporated in the diet.

Table 1. Composition of Dietary Treatments[a]

	Soybean meal, 44%		Casein	
Ingredient, %	Dextrose	Lactose	Dextrose	Lactose
Soybean meal, 44%	42.40	42.40	--	--
Casein	--	--	17.00	17.00
Dextrose	25.00	--	25.00	--
Lactose	--	25.00	--	25.00
Corn	18.20	18.20	43.60	43.60
Soybean oil	10.00	10.00	10.00	10.00
Salt	.50	.50	.50	.50
Dicalcium phosphate	2.50	2.50	2.65	2.65
Limestone	.55	.55	.40	.40
Trace minerals	.10	.10	.10	.10
Vitamins	.25	.25	.25	.25
Selenium	.15	.15	.15	.15
Copper sulfate	.10	.10	.10	.10
Antibiotic	.25	.25	.25	.25
Calculated composition, %				
Lysine	1.39	1.39	1.32	1.32
Ca	.89	.89	.85	.85
P	.78	.78	.74	.74
ME, kcal/lb	1716	1716	1635	1635

[a]Diets were formulated to contain .809% lysine, .515% Ca and .453% P per 1,000 kcal/lb of diet. The following ME concentrations (Kcal ME/kg) were assumed: SBM = 1584; casein = 1232; dextrose = 1668; dextrose = 1668.

Table 2. Apparent Digestible Energy Content of Treatments and Apparent Digestibility Coefficients for Trial 1, Periods 1 and 2

Item	Soybean meal, 44%		Casein	
	Dextrose	Lactose	Dextrose	Lactose
Period 1:				
Apparent Digestible Energy (DE), Kcal/lb[a]	1519	1577	1692	1734
Apparent Digestibility Coefficients (DC), %				
Dry matter (DM)[a]	83.1	83.4	89.5	88.8
Crude protein (CP)[a]	77.4	78.1	87.5	86.0
Fat[ab]	61.7	71.8	80.1	83.1
Total Carbohydrate (CHO)[c]	92.3	91.1	93.8	92.6
Period 2:				
Apparent Digestible Energy (DE), Kcal/lb[ab]	1666	1729	1783	1799
Apparent Digestibility Coefficients (DC), %				
Dry mater (Dm)[d]	88.4	89.4	92.2	90.3
Crude protein (CP)[a]	84.5	86.1	92.4	90.1
Fat[e]	79.9	85.2	91.1	90.1
Total Carbohydrate (CHO)	94.2	94.1	93.8	92.2

[a]SBM treatments < CAS treatments (P<.01).
[b]DEX treatments < LAC treatments (P<.05).
[c]Determined by difference.
[d]SBM treatments < CAS treatments (P<.07).
[e]PRO x CHO source interaction (P<.07).

Table 3. Ileal and Apparent Digestibility Coefficients for Trial 2.

Item	Soybean meal, 44%		Casein	
	Dextrose	Lactose	Dextrose	Lactose
Ileal Digestibility Coefficients (DC), %				
Dry matter (DM)[a]	46.8	65.5	77.3	78.3
Crude Protein (DM)[a]	43.0	70.2	70.2	78.7
Fat[c]	64.4	64.7	75.8	84.9
Total Carbohydrate (CHO)[d]	48.6	67.1	84.3	84.8
Apparent Digestibility Coefficients (DC), %				
Dry Matter (DM)[a]	77.7	86.0	84.7	85.4
Crude protein (CP)[d]	67.9	83.0	83.4	82.3
Fat	73.2	84.0	75.7	79.3
Total Carbohydrate (CHO)[d]	84.8	89.7	90.2	89.7

[a]PRO x CHO source interaction (P<.06).
[b]SBM treatments < CAS treatments (P<.06).
[c]DEX treatments < LAC treatments (P<.02).
[d]PRO x CHO source interaction (P<.03).