Kansas Agricultural Experiment Station Research Reports

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

Article 351

1987

Effect of protein and/or carbohydrate fractions of dried whey on performance and nutrient digestibility of weanling pigs

Michael D. Tokach

Jim L. Nelssen

G L. Allee

EFFECT OF PROTEIN AND/OR CARBOHYDRATE FRACTIONS OF DRIED WHEY ON PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEANLING PIGS

M.D. Tokach, J.L. Nelssen, and G.L. Allee

Summary

One hundred and eighty 3-wk old pigs (initial weight 10.6 lb) were utilized in a 35-day growth trial to determine the effects of the carbohydrate and/or protein fractions of dried whey on pig performance. In addition, 30 3-wk-old pigs (initial weight 10.8 lb) were used in two digestion trials to study the effects of the whey fractions on nutrient digestibility. Dietary treatments included a corn-soybean meal control (CON), control + 20% dried whey (WHE), control + 14% lactose (CHO), control + 2.1% lactalbumin (PRO), control + 14% lactose + 2.1% lactalbumin (CHO + PRO), and control + 8.4% whey protein concentrate (WPC). Diets were pelleted and balanced on an isolysine basis. Lactose and lactalbumin were added at the same levels as provided by a 20% dried whey diet. Pigs fed diets containing milk products exhibited superior average daily gain; feed efficiency; and apparent dry matter, energy, and nitrogen digestibility ($P<.05$) compared to pigs fed the control diet. These results indicate that both the carbohydrate (lactose) and protein (lactalbumin) fractions of dried whey are important in explaining the beneficial response to dried whey elicited by the weanling pig.

Introduction

Producers are currently weaning pigs at 4 wk of age or less to increase sow productivity. However, early weaning often results in a lag in pig performance, including decreased gain and feed intake and increased morbidity and mortality. Numerous universities have shown that dried whey is beneficial in eliminating postweaning lag by increasing average daily gain, feed intake, and feed efficiency. However, little research has been done to determine which fraction of dried whey is responsible for the improved performance. Therefore, the objective of the these studies was to determine whether the protein (lactalbumin) or carbohydrate (lactose) fraction of dried whey provides the beneficial growth response in the young pig.

Experimental Procedures

Three trials were conducted at the KSU swine research center. Composition of the dietary treatments is shown in table 1. Dried whey was assumed to contain 72% lactose and 10.5% lactalbumin. Therefore, the 20% dried whey diet (WHE) would contain 14.4% lactose and 2.1% lactalbumin. These assumptions were used to formulate the CHO, PRO, and CHO + PRO diets. The whey protein concentrate

diet (WPC) used in the growth trial was also formulated to contain 2.1% lactalbumin. All diets were pelleted and contained 1.3% lysine, .8% calcium, and .7% phosphorus.

35-day growth trial

One hundred eighty weanling pigs (21 ± 3 days) were allotted by sex and weight to the six dietary treatments. Average initial weight was 10.6 lb, with a range of 5.3 to 15.4 lb. Five replications per treatment were used with six pigs/pen. Pigs were housed in an environmentally controlled nursery in 4 x 5 ft pens with woven wire floors. Feed and water were offered ad libitum. Pig weights and feed intake were recorded weekly.

Digestion trials

In each of two trials, 15 pigs (average initial weight 10.8 lb) weaned at 16-18 days of age were randomly allotted by litter to dietary treatment. Pigs were brought to maximum feed intake during a 5-day adjustment period, with feces being collected for the next 5 days. Using a modified crossover design, pigs were then reallotted by litter but were not allowed to receive the same diet. This was followed by a second 5-day adjustment and 5-day collection period.

Results and Discussion

The dried whey and whey protein concentrate laboratory analysis is shown in table 2. The high lactose, low ash, and low salt levels indicate that a high quality, demineralized whey was used. This may have influenced the performance and digestibility of the 20% dried whey diet. In addition, a high quality whey protein concentrate containing 3.63% lysine was used . A high quality, edible grade whey must be used to obtain the optimum benefits of adding whey to starter diets. Research has shown that feed grade whey has little effect on starter pig performance.

The effect of dried whey fractions on weanling pig performance is shown in table 3. Pigs fed diets containing milk products had improved ($P<.05$) average daily gain (ADG) and feed efficiency (F/G) at 2 and 5 weeks postweaning, as compared to these fed the control. Pigs fed the PRO diet also tended to be more feed efficient ($P<.07$) than pigs fed the CHO diet after 5 weeks. No differences were found in average daily feed intake at 2 and 5 weeks. In addition, no significant differences in ADG at 2 and 5 weeks or feed efficiency at 2 weeks were found between the lactose (CHO) and lactalbumin (PRO) diets. Furthermore, no additive effect was found when the lactose and lactalbumin were added together in the CHO + PRO diet.

Figure 1 shows the effect of dried whey fractions on apparent digestibility. Since no trial by trial, trial by period, or period by period interactions were found, data were pooled for analysis. Pigs fed diets containing milk products had higher apparent dry matter, energy, and nitrogen digestibility than pigs fed the control. The higher digestibility for pigs fed diets containing milk product is consistent with the improved ADG and F/G found in the growth trial. Although differences were not significant between the CHO and PRO diets, the PRO diet was slightly higher in nitrogen digestibility and the CHO diet was slightly higher in energy

digestibility. These results would be expected, since the PRO and CHO diets contained the highly digestible dried whey protein and carbohydrate fractions, lactalbumin and lactose, respectively.

In summary, data from these trials indicate that milk products improve performance and nutrient digestibility in 3-wk old pigs. It appears that both the carbohydrate (lactose) and protein (lactalbumin) fractions of dried whey are important in explaining the dried whey response; however, when both fractions were present in the diet, no additive effects were found.

Table 1. Diet Composition, %[a]

Ingredients	Dietary Treatments[b]					
	CON	WHE	CHO	PRO	CHO + PRO	WPC
Corn	55.14	41.53	39.30	60.28	44.48	53.68
Soybean meal	38.07	32.25	39.43	30.68	32.00	31.23
Soybean oil	3.00	3.00	3.00	3.00	3.00	3.00
Dried whey	--	20.00	--	--	--	--
Lactose	--	--	14.40	--	14.40	--
Lactalbumin	--	--	--	2.10	2.10	--
Whey protein concentrate	--	--	--	--	--	8.34
Dicalcium phosphate	1.49	1.14	1.66	1.60	1.77	1.49
Limestone	.85	.63	.76	.89	.80	.81
Salt	.50	.50	.50	.50	.50	.50
Trace mineral mix[c]	.10	.10	.10	.10	.10	.10
Vitamin mix[d]	.25	.25	.25	.25	.25	.25
L-Lysine HCL	.10	.10	.10	.10	.10	.10
Selenium mix[e]	.15	.15	.15	.15	.15	.15
Antibiotic mix[f]	.25	.25	.25	.25	.25	.25
Copper sulfate[g]	.10	.10	.10	.10	.10	.10

[a]Diets were calculated to contain 1.3% lysine, .8% calcium, and .7% phosphorus.
[b]CON = control, WHE = control + 20% dried whey, CHO = control + 14.4% lactose, PRO = control + 2.1% lactalbumin, CHO + PRO = control + 14.4% lactose + 2.1 % lactalbumin, WPC = control + 8.34% whey protein concentrate.
[c]Percentage composition was Fe, 10; Zn, 10; Mn, 10; Cu, 1; I, .3; Co, .1.
[d]Composition per lb premix: vitamin A, 800,000 IU; vitamin D_3, 60,000 IU; vitamin E, 4000 IU; riboflavin, 900 mg; menadione, 310 mg; pantothenic acid, 2400 mg; niacin, 5000 mg; choline chloride, 92,200 mg; vitamin B_{12}, 4.4 mg.
[e]Diet contains .3 ppm selenium.
[f]Antibiotic contains 20 g chlortetracycline, 20 g sulfamethazine and 10 g penecillin per lb.
[g]Diets contain 250 ppm copper sulfate.

Table 2. Analyzed Ingredient Composition

Ingredient	Dried Whey	Whey Protein Concentrate
Protein, %	13.24	36.64
Lysine, %	.94	3.63
Lactose, %	80.50	50.20
Ash, %	1.24	6.08
Salt, %	.05	1.84

Table 3. Effect of Dried Whey Fractions on Weanling Pig Performance

Item	Dietary Treatment[a]					
	CON	WHE	CHO	PRO	CHO + PRO	WPC
Week 2						
Daily gain (lb)[b]	.51	.62	.64	.62	.58	.58
Daily feed (lb)	.63	.72	.74	.69	.65	.67
Feed/gain[b]	1.24	1.17	1.15	1.10	1.11	1.17
Week 5						
Daily gain (lb)[b]	.81	.93	.89	.90	.91	.89
Daily feed (lb)	1.24	1.36	1.33	1.28	1.30	1.28
Feed/gain[bc]	1.52	1.46	1.49	1.42	1.44	1.44

[a]CON = control, WHE = control + 20% dried whey, CHO = control + 14.4% lactose, PRO = control + 2.1% lactalbumin, CHO + PRO = control + 14.4% lactose + 2.1 % lactalbumin, WPC = control + 8.34% whey protein concentrate.
[b]Significant contrast, CON vs others ($P<.05$).
[c]Significant contrast, PRO vs CHO ($P<.07$).

Figure 1. Effect of Dried Whey Fractions on Apparent Digestibility