Using Whey In Swine Growing Finishing Rations

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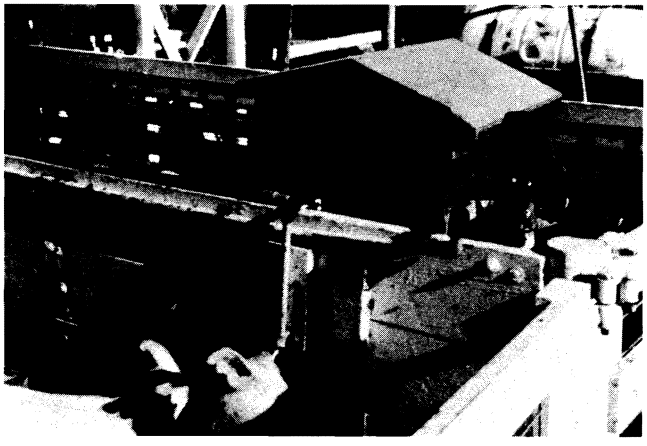

Figure 1. Pigs drinking whey from stainless steel nipple.

Figure 2. Pig drinking whey from stainless steel nipple.

Whey, a by-product of cheese making, is used in many ways in the production of food and feed, but the supply exceeds the demand. Consumption of cheese products has increased sevenfold in the last decade, with a proporational increase in the amount of whey produced. This has created serious disposal problems for cheese plants because both transporting the liquid whey to drying plants and the drying process are costly. Cheese plants such as the one at Dickinson have found it more economical to dump excess whey than to haul and process it. Dumping liquid whey has resulted in loss of a potential food and feed source, and in some cases has created pollution problems. Feeding liquid whey to pigs seemed to offer a partial solution to the disposal problem.

At the request of the North Dakota Dairy Products Commission, the Dickinson Experiment Station started swine feeding research with liquid whey furnished by the Dickinson Cheese Company. These trials were expanded to include dried sweet whey when it became available from the Whey-To-Go drying plant at Mandan.

The following experiments were conducted.

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Experiment One

One hundred eighty Yorkshire and Yorkshire X Hampshire barrows and gilts weighing approximately 40 pounds were randomly allotted and fed rations as shown in Table 1. Rations being compared were supplemented for protein with either soybean oilmeal, the synthetic amino acid L-Lysine, or liquid whey fed on a free choice basis. Liquid whey fed in experiment one contained less than 7 per cent dry matter consisting of approximately 5 per cent milk sugar, .3 per cent fat and .9 per cent protein. All rations were processed in a portable grinder-mixer and self fed in meal form. Liquid whey was fed free choice through a gravity flow system consisting of a fiberglass storage tank, PVC rigid wall plastic pipe and stainless steel nipple waterers. During the first two weeks of feeding both whey and water were available to allow the pigs time to become accustomed to whey. Following the adjustment period, liquid whey served as the only source of water and protein supplement. The nipple waterers were located 28 inches above floor level in an arrangement designed to reduce waste. One half of the pigs were housed in an open air confinement system, with the remainder housed in lots planted to spring seeded winter wheat as a grazing crop. The pigs were weighed every 28 days, and were marketed at an average of 220 pounds.

Table 1. Rations fed to growing-finishing pigs.

A. Experiment One.

Ingredient		Ration Supplement SBOM	Lysine	Liquid Whey
Oats, lbs.		200	234	236
Barley, lbs.		676	739	740
Soybean oilmeal, lbs.		100	—	—
Lyamine - 50 (50% L-lysine)		—	3	—
Minerals, vitamins[1]		24	24	24
Price/ton, $	1973	70	60	49
	1974	111	109	102
	1975	132	129	126
3-year average cost/lb.,$		.0520	.0495	.0460

[1]Includes: Limestone 9 lbs, di-cal 9 lbs., trace mineral salt 5 lbs., vitamin B complex 1 lb., 30 gms. vitamin A, 14 gms. vitamin D_3 and 180 gms. zinc sulphate.

Experiment Two

In the second experiment, 110 Yorkshire and Yorkshire X Hampshire barrows and gilts averaging 40 pounds were used to compare the substitution value of dried sweet whey with barley in growing-finishing rations. The trial also measured the optimum amount of whey that could be fed without causing diarrhea and/or suppression of gain. Dried whey containing approximately 73 per cent lactose, on a dry matter basis, has been shown to have a laxative effect when fed to weanling pigs. Becker, et al (1957) and Krider, et al (1949) reported that weanling pigs on rations containing 4, 8, and 20 per cent whey developed diarrhea, and Shearer, et al (1968) reported that diarrhea became progressively worse as lactose levels were increased from 15 to 40 per cent. However, gain suppression was experienced only at the 30 to 40 per cent lactose levels. The control ration fed in experiment two contained no whey. It was compared with trial rations in which dried whey replaced 15, 30 and 45 per cent of the barley in the ration. Lactose levels in the trial rations were 10, 21 and 32 per cent, respectively. Equal amounts of oats were included in all rations, which were formulated to contain 15.7 per cent crude protein in the growing phase and 12.7 per cent in the finishing phase.

B. Experiment Two.

Growing ration as fed from start to 120 pounds.

Ingredients in pounds	No. 1 0% Whey	No. 2 15% Whey	No. 3 30% Whey	No. 4 45% Whey
Dried sweet whey	—	150	300	450
Oats	284.5	284.5	284.5	284.5
Barley	572	425	278	131
SBOM	120	120	120	120
Di-cal	6	5	4	3
Limestone	11	9	7	5
Vitamins & minerals[1/2/]	6.5	6.5	6.5	6.5
Total	1,000	1,000	1,000	1,000
Finishing ration fed from 120 pounds to market.				
Dried sweet whey	—	150	300	450
Oats	284.5	284.5	284.5	284.5
Barley	673	525	378	231
SBOM	20	20	20	20
Di-cal	6	5	4	3
Limestone	10	9	7	5
Vitamins & minerals[1/3/]	6.5	6.5	6.5	6.5
Total	1,000	1,000	1,000	1,000

[1/]Includes trace mineral salt, 5 lbs; vitamin B complex, 1 lb.; vitamin A, 30 grams; vitamin D, 14 grams; and zinc sulfate, 180 grams.

[2/]Growing ration calcium and phosphorus averaged 0.62% and 0.53%.

[3/]Finishing ration calcium and phosphorus averaged 0.60% and 0.51%.

Experiment Three

Forty-eight Yorkshire and Yorkshire X Hampshire barrows and gilts averaging 53 pounds were randomly allotted and fed rations containing either 15 or 30 per cent dried whey, in combination with wheat, oats and barley. In each ration barley and oats were held constant, with the dried sweet whey replacing either 15 or 30 per cent of the wheat. Crude protein levels were 16.0 per cent in the growing ration and 13.5 per cent in the finishing ration. At market weight all barrows were sold on a grade and yield basis to the Hormel slaughtering plant, where carcass measurements were made.

Summary

Liquid sweet whey fed as the only source of water and supplemental protein promoted satisfactory and economical gains in growing and finishing pigs fed to market weights. Pigs fed rations supplemented with soybean oilmeal or the synthetic amino acid L-Lysine made faster gains and were heavier at the end of the trial. However, liquid whey fed pigs were more efficient in their gains. Feeding liquid whey resulted in feed saving of 107 pounds less feed per 100 pounds gain. This amounted to a saving of $7.60 per 100 pounds gain over the soybean meal supplemented pigs and $5.94 per 100 pounds gain over the L-Lysine supplemented hogs.

Pigs adjusted to liquid whey very easily without scouring or diarrhea problems when both liquid whey and water were available free choice for approximately two weeks before water was discontinued.

Whey feeding will be most successful when there is a readily available supply of salt-free whey within 25 miles of the hog farm; when pigs weigh at least 35 pounds at the beginning of the feeding period; and when a closed whey delivery system composed of either plastic or stainless steel components is used. This closed system reduces contamination, odors, and fly problems to a minimum. However, spilled or wasted whey is very corrosive to concrete, which may cause a problem.

Results from experiment two indicate that dried sweet whey can replace up to 45 per cent of the barley in growing-finishing rations. Problems with diarrhea reported by earlier researchers were not evident in this trial even at the highest level of whey. Gain of pigs fed 15, 30, and 45 per cent whey were significantly better then pigs fed the control ration which contained no whey. All whey rations were lower in fiber content than the basic barley-oats control ration and this resulted in faster gains and improved feed efficiency.

Pigs fed 15 and 30 per cent whey rations required 9 per cent less feed per pound of gain and those fed the 45 per cent ration consumed 11 per cent less feed per pound of gain than did pigs fed the control ration.

C. Experiment Three.

Growing ration as fed from the start to 120 pounds.

Ingredients in pounds	15% Whey wheat + barley	30% Whey wheat + barley	15% Whey wheat + oats	30% Whey wheat + oats
Dried sweet whey	150	300	150	300
Oats	330	183	–	–
Barley	–	–	330	183.5
Winter wheat	400	400	400	400
SBOM	99.5	99.5	99.5	99.5
Di-cal	5	4	4	4
Limestone	9	7	10	7.5
Vitamins & minerals[1,2]	6.5	6.5	6.5	6.5
Total	1,000	1,000	1,000	1,000

Finishing ration as fed from 120 pounds to market weight.

Dried sweet whey	150	300	150	300
Oats	409	263	–	–
Barley	–	–	411	263
Winter wheat	400	400	400	400
SBOM	20	20	20	20
Di-cal	6	4	4	4
Limestone	9	7	9	7
Vitamins & minerals[1,3]	6.5	6.5	6.5	6.5
Total	1,000	1,000	1,000	1,000

1/ Includes: trace mineral salt 5 lbs.; vitamin B complex 1 lb.; vitamin A 30 gms.; vitamin D 14 gms., and zinc sulfate 180 gms.

2/ Growing ration: calcium and phosphorous averaged 0.66% and 0.53%.

3/ Finishing ration: calcium and phosphorous averaged 0.61% and 0.51%.

Net returns at all levels of whey feeding were higher than the basic ration which contained no whey. Although the 45 per cent level of whey was the most efficient in terms of feed per pound of gain, including whey at this level increased ration costs more than could be offset by the increase in feed efficiency. Net returns for the 30 to 45 per cent groups amounted to $3.04 and $3.13 more than for the control ration. The most economical ration contained 15 per cent dried whey and yielded $4.51 more net return than did the control. Only slight differences in carcass measurements were found, and these were more likely due to genetics than to ration type.

The third investigation evaluated dried sweet whey when fed in combination with either Hard Red Spring wheat and oats or Hard Red Spring wheat and barley.

Results of this experiment were similar to those obtained in trial two. No feeding problems of any kind were encountered and the rations produced satisfactory and economical gains. Statistically, pigs fed 30 per cent whey gained better than those fed at the 15 per cent level, but were not the most economical. Rations containing 15 per cent whey were cheaper to mix and resulted in less feed being required per pound of gain. This resulted in a net return of $3.75 more per head than pigs fed the 30 per cent whey rations.

Loin eye muscle area was significantly larger in pigs fed the 30 per cent whey rations compared with pigs raised on the 15 per cent rations.

Table 2. Response of growing-finishing pigs fed in experiments one, two and three.

A. Experiment One. (Three year average)

	Ration supplement					
	Whey		SBOM		Lysine	
	Pasture	Confinement	Pasture	Confinement	Pasture	Confinement
Initial wt., lbs.	35	51	34	51	35	51
Final wt., lbs.	190	205	200	211	192	217
Gain, lbs.	156	154	165	160	158	166
Days fed	127	117	127	117	127	117
Avg. daily gain, lbs.	1.22	1.31	1.30	1.36	1.24	1.42
Cost/lb. of feed,$	.046	.046	.052	.052	.0495	.0495
Feed/cwt gain, lbs.	285	297	410	397	395	386
Feed cost/cwt gain,$	13.11	13.66	21.32	20.64	19.55	19.10

B. Experiment 2.

	No Whey	15%	30%	45%
No. head	27[2]	27[2]	28	28
No. days on feed	110	110	110	110
Initial wt., lbs.	47	47.5	46.5	46.5
Final wt., lbs.	207.5	227	232.5	228.5
Total gain, lbs.	160.5	179.5	186	181.5
ADG, lbs.	1.47	1.64	1.70	1.66
Feed/hd/day, lbs.	5.85	5.98	6.15	5.88
Feed/lb gain, lbs.	3.96	3.64	3.63	3.55
Cost/lb feed,$	.0555	.0576	.0612	.0620
Cost/cwt gain,$	21.98	20.94	22.22	21.94
Feeding economics:				
Return/hd @ $35/cwt	76.77	83.96	85.86	84.42
Feed cost/hd,$	-35.28	-37.96	-41.33	-39.80
Feeder pig cost/hd,$	-26.67	-26.67	-26.67	-26.67
Net return,$[1]	14.82	19.33	17.86	17.95
		4.51	3.04	3.13

[1] Net return figure is market value less cost of feeder pig and feed costs, and does not include costs for veterinary supplies, equipment, housing, depreciation, taxes, insurance, etc.

[2] One pig removed from trial due to pneumonia, and the other due to lameness.

Table 3. Carcass summary from experiments two and three.

	No whey	15%	30%	45%
Experiment 2.				
Carcass length, in.	31.4	31.4	31.5	31.6
10th rib backfat, in.	81	1.0	1.0	.90
Loin eye muscle quality	2.7	2.8	2.4	2.6
Loin eye area, sq. in.	4.8	4.2	4.9	4.8
Percent lean meat	55.8	52.8	54.0	54.7
Experiment 3	**15% whey wheat + barley**	**30% whey wheat + barley**	**15% whey wheat + oats**	**30% whey wheat + oats**
Carcass length, in.	31.5	32.4	31.3	31.6
10th rib backfat, in.	1.4	1.3	1.2	1.4
Loin eye muscle quality	2.5	2.6	3.0	2.7
Loin eye area, sq. in.	3.6	4.3	3.5	3.9
Percent lean meat	47.6	50.5	49.3	48.2

Table 4. Approximate composition of feedstuffs used in this trial compared to whole milk.

	Dry whole milk[1]	Dried sweet whey[1]	HRS wheat[2]	U.S. No. 1 barley[2]	U.S. No. 1 oats[2]
Dry matter	97.8	95.4	100	100	100
Crude fiber	–	–	3.4	5.6	12.4
Ether extract (fat)	26.8	1.3	2.2	2.1	5.1
N-free extract (carbohydrate)	38.0	73.3	76.3	76.6	65.7
Protein (Nx6.25)	26.0	12.0	16.1	13.0	13.2
Swine digestible protein %	26	10.9	14.8	9.2	11.1
Energy:					
Swine DE Kcal/kg	5500	3651	4012	3461	3213
Ash (minerals)	6.0	10.3	2.0	2.7	3.6
Calcium,%	0.97	0.7	.06	.27	.11
Phosphorous,%	0.75	0.6	.47	.41	.39
Sodium,%	0.38	1.25	.10	.02	.07
Vitamin A (IU/kg)	2250	101	31	144	38
Riboflavin, (Mg/kg)	3.0	5.1	1.3	2.2	1.8
Thiamine, (Mg/kg)	.54	.9	6.0	5.7	7.0
Niacine (Mg/kg)	1.4	1.9	66.8	64.5	17.8
Pantothenic acid (Mg/kg)	5.9	9.6	15.6	7.3	14.5
Pyridoxine, (Mg/kg)	.68	.7	–	3.3	1.3
Biotin (Mg/kg)	.09	.09	.10	.20	.30
Choline (Mg/kg)	181.4	494.4	899	1157	1206
Ascorbic acid (Mg/kg)	16.6	–	–	–	–
Folic acid (Mg/kg)	.1	.2	.48	.60	.40
Vitamin B_{12} (Mg/kg)	.0008	.004	–	–	–

[1]Analysis from Minnesota Valley Testing Laboratories, Inc., New Ulm, Minnesota.

[2]From Applied Animal Nutrition, 1969, 2nd Ed; Crampton, E. W. and L. E. Harris.

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