Kansas Agricultural Experiment Station Research Reports

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

Article 31

2010

The effects of feeder design and changing the availability of water from a wet-dry feeder at 4 and 8 weeks prior to marketing on growth performance and carcass characteristics of growing-finishing pigs (2010)

J R. Bergstrom

Michael D. Tokach

Jim L. Nelssen

The effects of feeder design and changing the availability of water from a wet-dry feeder at 4 and 8 weeks prior to marketing on growth performance and carcass characteristics of growing-finishing pigs (2010)

Authors

J R. Bergstrom, Michael D. Tokach, Jim L. Nelssen, Joel M. DeRouchey, Robert D. Goodband, and Steven S. Dritz

The Effects of Feeder Design and Changing the Availability of Water from a Wet-Dry Feeder at 4 and 8 Weeks Prior to Marketing on Growth Performance and Carcass Characteristics of Growing-Finishing Pigs[1]

J. R. Bergstrom, M. D. Tokach, S. S. Dritz[2], J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband

Summary

A total of 1,296 pigs (PIC, 337 × 1050) were used to evaluate the effects on growth performance and carcass characteristics of feeder design (conventional dry feeder vs. wet-dry feeder) and changing availability of water from a wet-dry feeder at 4 and 8 wk prior to marketing. There were 27 pigs per pen (14 barrows and 13 gilts) and 24 pens per feeder-type. Pigs were fed identical corn-soybean meal diets with 15% dried distillers' grains with solubles (DDGS). Pens with a wet-dry feeder had a separate cup waterer, but the feeder provided the sole water source until d 69. The water supply to the wet-dry feeder was shut off in 8 pens on d 69 (WD8) and another 8 pens on d 97 (WD4), and the cup waterer was turned on. For the remaining 8 pens, the wet-dry feeder provided the sole water source for the entire experiment (WD0). From d 0 to 69, pigs using the wet-dry feeder had improved ($P < 0.05$) ADG, ADFI, F/G, and d 69 BW. Overall (d 0 to 124), pigs using WD0 had greater ($P < 0.05$) ADG, ADFI, final BW, and HCW than all other treatments. Pigs using WD4 had greater ($P < 0.05$) ADG than pigs that used a conventional dry feeder, and WD8 was intermediate. Pigs using WD4 had greater ($P < 0.05$) ADFI than WD8, and conventional dry was intermediate. Pigs using WD0 had poorer ($P < 0.05$) F/G than WD8 and conventional dry, and pigs using WD4 were intermediate. Backfat depth of pigs using WD8 was reduced ($P < 0.05$) compared to all other treatments, and loin depth was greater ($P < 0.05$) than that of pigs using a conventional dry feeder and WD4. Loin depth of pigs using WD0 was also greater ($P < 0.05$) than that of pigs with the conventional dry feeder. The percentage fat-free lean of pigs using WD8 was greater ($P < 0.05$) than WD4, and WD0, and pigs that used the conventional dry feeder were intermediate. Income-over-feed cost was numerically greatest for pigs using WD8. In conclusion, pigs using WD0 had better growth rates than pigs using the conventional dry feeder, WD4, or WD8. Although measures of carcass leanness were improved with WD8, the reduction in growth rate observed for this treatment during the last 8 wk eliminated any net improvement in the overall growth rate from using a wet-dry feeder.

Key words: conventional feeder, water, wet-dry feeder

[1] Appreciation is expressed to New Horizon Farms for use of pigs and facilities and to Richard Brobjorg, Scott Heidebrink, and Marty Heintz for technical assistance.

[2] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

Introduction

Recent research at Kansas State University (Bergstrom et al., 2008[3] and 2009[4]) has demonstrated that using a wet-dry feeder improves the feed intake and growth rate of finishing pigs, but they may also have poorer feed efficiency and greater backfat depth. These differences in feed efficiency and leanness are of concern because they may eliminate the potential benefits associated with an improved growth rate.

Because the greater growth rate may be responsible for the poorer F/G and greater backfat depth, research may be beneficial to identify methods to sustain the improved growth rate obtained with a wet-dry feeder during the early finisher period and slow the late-finishing growth to a similar level as from a dry feeder. A wet-dry feeder typically provides fewer eating spaces than a conventional dry feeder because the eating behavior of pigs fed with a wet-dry feeder is different than that of pigs eating from a conventional dry feeder (Gonyou and Lou, 2000[5]). Also, as pigs grow, the number of meals and time spent at the feeder typically decreases while the rate of consumption increases (Hyun et al., 1997[6]). With 12 pigs per pen and an initial BW of 119 pounds, Amornthewaphat et al. (2000[7]) demonstrated that the performance of finishing pigs using a single-space, wet-dry feeder design with water provided separately was similar to those using a two-hole conventional dry feeder. This indicates that the increased growth observed with a wet-dry feeder may be due to the availability of water with feed, rather than the design of the feeder, and that the wet-dry feeder may provide adequate space when used as a dry feeder in late finishing. However, the effects of changing the source of water from a wet-dry feeder to a separate source (while maintaining an otherwise adequate supply) on growing-finishing pig performance have not been reported.

Therefore, the objective of this research was to evaluate the effects of feeder design and changing the availability of water from a wet-dry feeder at 4 and 8 weeks prior to marketing on growth performance and carcass characteristics of growing-finishing pigs.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved procedures used in the experiment, which was conducted in a commercial research finishing facility in southwestern Minnesota. The facility was double-curtain sided with pit fans for minimum ventilation and completely slatted flooring over a deep pit for manure storage. Individual pens were 10 × 18 ft. One-half of the pens were equipped with a single 60-in.-wide, 5-hole conventional dry feeder (STACO, Inc., Schaefferstown, PA) and a cup waterer in each pen (Figure 1). Each remaining pen was equipped with a double-sided, wet-dry feeder (Crystal Springs, GroMaster, Inc., Omaha, NE) with a 15-in.-wide feeder opening on both sides to provide access to feed and water (Figure 2). All pens that were equipped with a wet-dry feeder also contained a cup waterer. Both sources of water for the pens with a wet-dry feeder were equipped with individual shut-off valves so the water source could be selected or changed.

---

[3] Bergstrom et al., Swine Day 2008, Report of Progress 1001, pp. 196-203.

[4] Bergstrom et al., Swine Day 2009, Report of Progress 1020, pp. 252-261.

[5] Gonyou, H. W. and Z. Lou. 2000. Effects of eating space and availability of water in feeders on productivity and eating behavior of grower/finisher pigs. J. Anim. Sci. 78:865-870.

[6] Hyun et al. 1997. Feed intake pattern of group-housed growing-finishing pigs monitored using a computerized feed intake recording system. J. Anim. Sci. 75:1443-1451.

[7] Amornthewaphat et al. Swine Day 2000, Report of Progress 858, pp. 123-126.

A total of 1,296 pigs (PIC, 337 × 1050, initially 42.8 lb) were used to evaluate the effects of feeder design (conventional dry vs. wet-dry feeder) and changing availability of water from a wet-dry feeder on growing-finishing pig performance. Pigs were weighed and allotted to the 2 feeder types. There were 27 pigs per pen (14 barrows and 13 gilts) and 24 pens per feeder-type. All pigs were fed the same corn-soybean meal diets with 15% DDGS during 4 dietary phases (Table 1). The last dietary phase contained ractopamine HCl (Paylean), and was initiated on d 97. Pens with a wet-dry feeder had a separate cup waterer, but the wet-dry feeder provided the sole water source until d 69. On d 69, water to the wet-dry feeder was shut off and the cup waterer turned on in 8 of the pens with a wet-dry feeder (WD8). This process was repeated with an additional 8 pens equipped with a wet-dry feeder on d 97 (WD4). For the remaining 8 pens with wet-dry feeders, the feeder provided the sole source of water for the entire experiment (WD0).

Pen and feeder weights were measured on d 14, 28, 42, 56, 69, 97, and 124 to determine average BW, ADG, ADFI, F/G, and feed cost per pig. On d 104, 3 pigs (2 barrows and 1 gilt) from each pen were weighed and removed for marketing. At the conclusion of the experiment on d 124, carcass data were obtained for 829 pigs from 38 pens (20 conventional dry and 18 wet-dry) to determine the effects of feeder treatment on HCW, yield, backfat depth, loin depth, fat-free lean index (FFLI), revenue per pig, and income-over-feed cost (IOFC).

Data were analyzed using a completely randomized design and the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) to compare the effects of the 2 feeder types (wet-dry vs. conventional dry) from d 0 to 69, and the 3 wet-dry feeder (WD0, WD4, and WD8) and single conventional dry feeder treatments from d 69 to 124 and overall (d 0 to 124). Pen was the experimental unit.

Results

During the initial period, from d 0 to 69, pigs using the wet-dry feeder had greater ($P < 0.05$) ADG, ADFI, d 69 BW, and better F/G than those using the conventional dry feeder (Table 2).

When the availability of water for WD8 was switched from the feeder to the cup on d 69, pigs fed using WD0 and WD4 had greater ($P < 0.05$) ADG, ADFI, and ending BW from d 69 to 97 than pigs that used the conventional dry feeder and WD8. Also, pigs fed using the conventional dry feeder had greater ($P < 0.05$) ADG and ADFI than that of pigs using WD8. Pigs fed with conventional dry and WD4 had improved ($P < 0.05$) F/G compared to WD8, and the F/G of WD0 was intermediate.

When the availability of water for WD4 was switched from the feeder to the cup on d 97, pigs fed using WD0 had greater ($P < 0.05$) ADG than those that used the conventional dry feeder and WD4 from d 97 to 124, and ADG of WD8 and conventional dry was also greater ($P < 0.05$) than that of WD4. Pigs fed using WD0 had greater ($P < 0.05$) ADFI and ending BW than all other treatments. The F/G of pigs fed using WD8 was improved ($P < 0.05$) when compared to WD0 and WD4. The F/G of conventional dry was intermediate to WD8 and WD0, but was improved ($P < 0.05$) compared to WD4.

Overall (d 0 to 124), pigs fed using WD0 had greater ($P < 0.05$) ADG than all other feeder treatments. Among the other treatments, pigs fed using WD4 had greater ($P < 0.05$) ADG than pigs that used the conventional dry feeder, and that of pigs using WD8 was intermediate. The ADFI of pigs fed with WD0 was also greater ($P < 0.05$) than all other feeder treatments. However, pigs fed using WD4 had greater ADFI than those using WD8, and conventional dry feeder was intermediate. Pigs fed with WD0 had poorer ($P < 0.05$) F/G than those fed with WD8, but pigs fed with WD4 and conventional dry were intermediate. The final BW and HCW of pigs using WD0 were greater ($P < 0.05$) than that of all other feeder treatments. Backfat depth was reduced ($P < 0.05$) for pigs fed using WD8 compared to all other feeder treatments. Loin depth of pigs fed using WD8 was greater ($P < 0.05$) than that of pigs fed with WD4 and pigs that used the conventional dry feeder. Additionally, pigs fed using WD0 had greater ($P < 0.05$) loin depth than pigs that used the conventional dry feeder, with treatment WD4 being intermediate. The fat-free lean index (FFLI) of pigs fed using WD8 was greater ($P < 0.05$) than that of pigs using WD4, and WD0 and conventional dry treatments were intermediate. Despite the differences in growth and carcass characteristics, there were no significant differences in revenue per pig, feed cost per pig, and income-over-feed cost per pig (IOFC) among the treatments.

Discussion

As in previous experiments, ADG, ADFI, and final BW were increased with a wet-dry feeder during the first 69 d. However, when the availability of water was switched from the wet-dry feeder to a cup waterer, ADG and ADFI declined immediately after the switch. Although the ADFI and ADG of the pigs receiving the WD8 treatment were similar to those of pigs that used the conventional dry feeder treatment from d 97 to 124, the reduction in performance observed from d 69 to 97 eliminated the benefit of water availability in the feeder from d 0 to 69. Therefore, the overall growth performance of WD8 treatment and the conventional dry feeder were not different.

Unlike some recent experiments, backfat depth and FFLI were not different between the WD0 and conventional dry feeder treatments. Although the pigs fed with WD0 had a greater final BW and HCW, they also had a numerically greater feed cost per pig. Therefore, there was not a significant difference in IOFC. However, it is interesting that the backfat depth of pigs fed using WD8 declined, and their loin depth was greater, compared to that of pigs fed with the conventional dry feeder. This was accomplished with similar overall growth performance and final BW, but contributed to the numerically greater IOFC for pigs using WD8. The backfat depth and FFLI of pigs fed with WD0, WD4, and the conventional dry feeder were very similar, and they also had similar IOFC.

These data suggest that the availability of water with feed in the wet-dry feeder was responsible for the improved ADFI and ADG. The performance of pigs fed with WD8 was similar from d 97 to 124 to that of pigs fed with the conventional dry feeder, indicating that the wet-dry feeder design provided adequate feeder space for late-finishing pigs when used as a "dry" feeder with water provided separately. However, the abrupt change in the availability of water from WD8 to a separate cup waterer on d 69 resulted in a considerable reduction in ADG and ADFI during an apparent adaptation period from d 69 to 97. Although this feeder management strategy successfully slowed the late-finishing growth of pigs fed from the wet-dry feeder and resulted in reduced carcass backfat depth, the earlier benefits of using the wet-dry feeder to increase growth rate and BW were lost.

In conclusion, using the wet-dry feeder (WD0) improved ADG, ADFI, final BW, and HCW of growing-finishing pigs in this experiment. However, changing the availability of water from the wet-dry feeder to a separate cup waterer at 8 wks prior to marketing (WD8) resulted in similar overall growth performance to that of pigs fed with a conventional dry feeder, but with less carcass backfat and greater loin depth. Changing the availability of water from the wet-dry feeder to a separate waterer at 4 weeks prior to marketing (WD4) resulted in ADG that was intermediate to pigs fed with WD0 and the conventional dry feeder. Although pigs fed with WD0 had a heavier final BW, the numerically greater feed cost per pig resulted in similar IOFC to those fed using the conventional dry feeder. The FFLI and IOFC of pigs fed using WD8 were numerically greater than the other treatments. Abruptly changing the source of water from the wet dry-feeder to a separate source clearly reduced growth performance in the subsequent time period when compared to the performance of pigs fed with the conventional dry feeder. Changing the water source at 8 weeks prior to market reduced backfat depth at market compared to pigs fed with the wet-dry feeder throughout the finishing phase. Although further refinements are needed, this demonstrates that switching the water source away from the feeder during the finishing period may be a way to mitigate the negative effects of wet-dry feeders on backfat depth. Feeder design and provision of water, as well as their management, influence the growth of growing-finishing pigs.

Table 1. Diet composition[1]

	Dietary phase			
Item	50 to 100 lb	100 to 160 lb	160 to 225 lb	225 lb to mkt.
Ingredient, %				
Corn	61.46	66.53	71.45	63.35
Soybean meal (46.5% CP)	21.43	16.64	11.85	19.80
DDGS[2]	15.00	15.00	15.00	15.00
Monocalcium P (21% P)	0.15	---	---	---
Limestone	1.00	0.95	0.90	1.00
Salt	0.35	0.35	0.35	0.35
Liquid lysine (60% Lys)	0.45	0.40	0.35	0.35
L-Threonine	0.05	0.03	0.01	0.01
VTM + phytase[3]	0.11	0.10	0.09	0.085
Paylean, 9 g/lb	---	---	---	0.025
Total	100.00	100.00	100.00	100.00
Cost, $/lb[4]	0.120	0.116	0.112	0.124
Calculated analysis				
Standardized ileal digestible (SID) amino acids				
Lysine, %	1.05	0.90	0.75	0.95
Isoleucine:lysine, %	64	66	69	68
Leucine:lysine, %	158	172	191	170
Methionine:lysine, %	28	30	33	30
Met & Cys:lysine, %	57	62	68	61
Threonine:lysine, %	62	63	64	62
Tryptophan:lysine, %	17	17	17	18
Valine:lysine, %	75	79	84	80
CP, %	19.3	17.5	15.7	18.7
Total lysine, %	1.19	1.03	0.87	1.09
ME, kcal/lb	1,523	1,527	1,529	1,526
SID lysine:ME ratio, g/Mcal	3.13	2.67	2.23	2.82
Ca, %	0.50	0.44	0.41	0.47
P, %	0.46	0.41	0.39	0.42
Available P, %	0.29	0.25	0.23	0.21

[1] Each dietary phase was formulated to meet the requirements for the BW ranges described in the table.
[2] Dried distillers grains with solubles.
[3] VTM = Vitamin and trace mineral premix. The phytase source, Optiphos 2000, provided 0.12% available P.
[4] Ingredient prices used were: corn, $195/ton; soybean meal, $325/ton; dried distillers grains with solubles, $160/ton; limestone, $50/ton; salt, $60/ton; liquid lysine, $1,600/ton; vitamin and trace mineral premix, $3,200/ton; phytase, $5,300/ton; Paylean, $57,000/ton; and $12/ton processing and delivery fee.

Table 2. The effects of feeder design and changing the availability of water from a wet-dry feeder at 4 and 8 wk prior to marketing on growth performance and carcass characteristics of growing-finishing pigs[1]

Feeder design:	Wet-dry feeder (WD)					
Water with feed:	throughout (WD0)	to d 97 (WD4)	to d 69 (WD8)	Conventional dry (CD) w/separate cup waterer	SEM	WD vs. CD *P* <
Growth performance						
d 0 to 69						
ADG, lb	1.84	1.81	1.80	1.74	0.027	0.001
ADFI, lb	4.18	4.08	4.03	3.96	0.067	0.02
F/G	2.27	2.25	2.24	2.28	0.015	0.05
d 69 BW, lb	171.0	168.6	167.7	163.3	1.81	0.001
d 69 to 97[2]						
ADG, lb	1.93[a]	1.99[a]	1.62[b]	1.82[c]	0.037	---[3]
ADFI, lb	6.12[a]	6.07[a]	5.29[b]	5.69[c]	0.067	---
F/G	3.18[ab]	3.07[a]	3.28[b]	3.13[a]	0.052	---
d 97 BW, lb	225.3[a]	224.3[a]	213.6[b]	214.6[b]	1.76	---
d 97 to 124						
ADG, lb	2.33[a]	2.01[b]	2.24[ac]	2.18[c]	0.064	---
ADFI, lb	6.81[a]	5.86[b]	6.11[b]	6.12[b]	0.135	---
F/G	2.93[ab]	2.95[b]	2.73[c]	2.81[ac]	0.058	---
d 0 to 124						
ADG, lb	1.96[a]	1.89[b]	1.84[bc]	1.84[c]	0.017	---
ADFI, lb	5.14[a]	4.88[b]	4.73[c]	4.78[bc]	0.042	---
F/G	2.63[a]	2.58[ab]	2.56[b]	2.60[ab]	0.017	---
d 124 BW, lb	283.8[a]	274.9[b]	269.5[b]	270.1[b]	2.38	---
Carcass & economics[4]						
HCW, lb	211.7[a]	205.6[b]	201.9[b]	203.7[b]	2.26	---
Yield, %	75.4	75.4	75.4	75.9	0.41	---
Backfat depth, in.	0.77[a]	0.78[a]	0.70[b]	0.74[a]	0.019	---
Loin depth, in.	2.43[ab]	2.31[bc]	2.55[a]	2.30[c]	0.065	---
FFLI[5]	49.5[ab]	49.2[a]	50.0[b]	49.6[ab]	0.24	---
Revenue/pig, $	129.45	125.88	126.28	125.23	2.057	---
Feed cost/pig, $	75.86	73.41	70.23	72.81	2.435	---
IOFC[6], $	53.59	52.45	56.05	52.42	2.101	---

[1] A total of 1,296 pigs (PIC, 337 × 1050, initially 42.8 lb) were placed in 48 pens containing 27 pigs each.

[2] Means within the same row having different superscripts differ ($P < 0.05$).

[3] The main effects of feeder design were not compared for response criteria beginning on d 69, and the differences between feeder treatments were determined using the PDIFF option of SAS.

[4] Carcass data were obtained for 829 pigs from 38 pens (20 conventional dry and 18 wet-dry feeders) to determine the effects of feeder treatment on carcass characteristics and profitability.

[5] FFLI = fat-free lean index.

[6] IOFC = income over feed cost, calculated by subtracting the feed cost/pig from the revenue/pig determined using premiums/discounts and a base live price of $44.73/cwt.

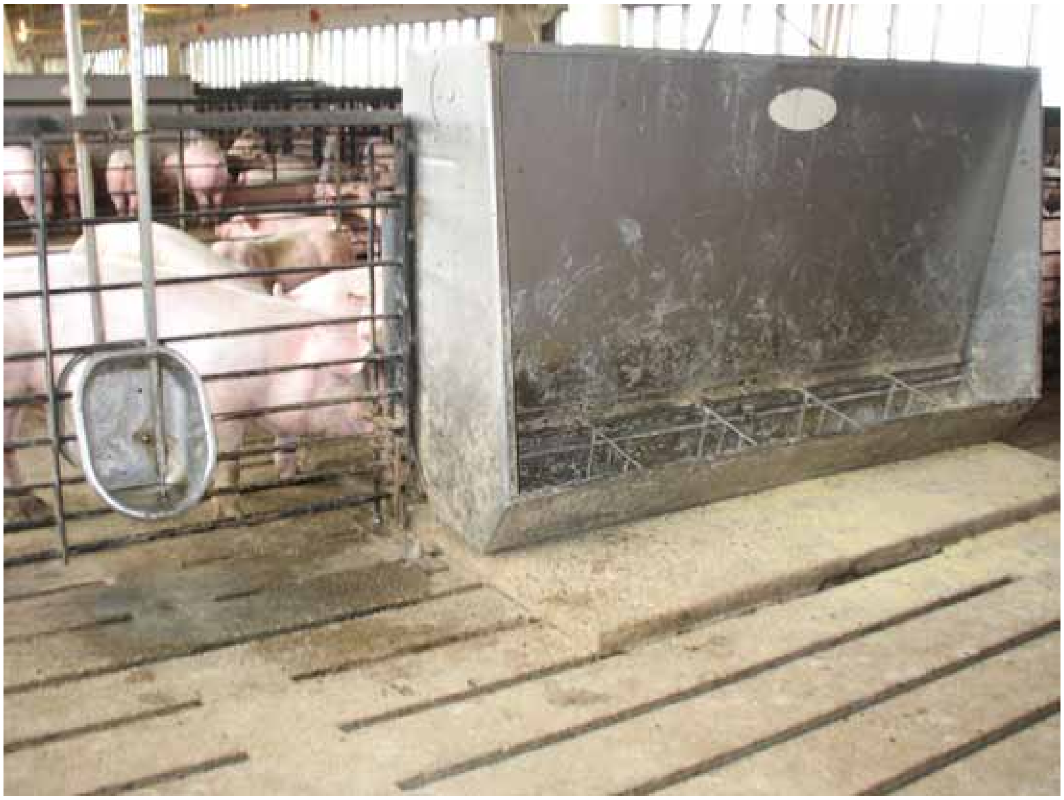

Figure 1. Conventional dry feeder with cup waterer.

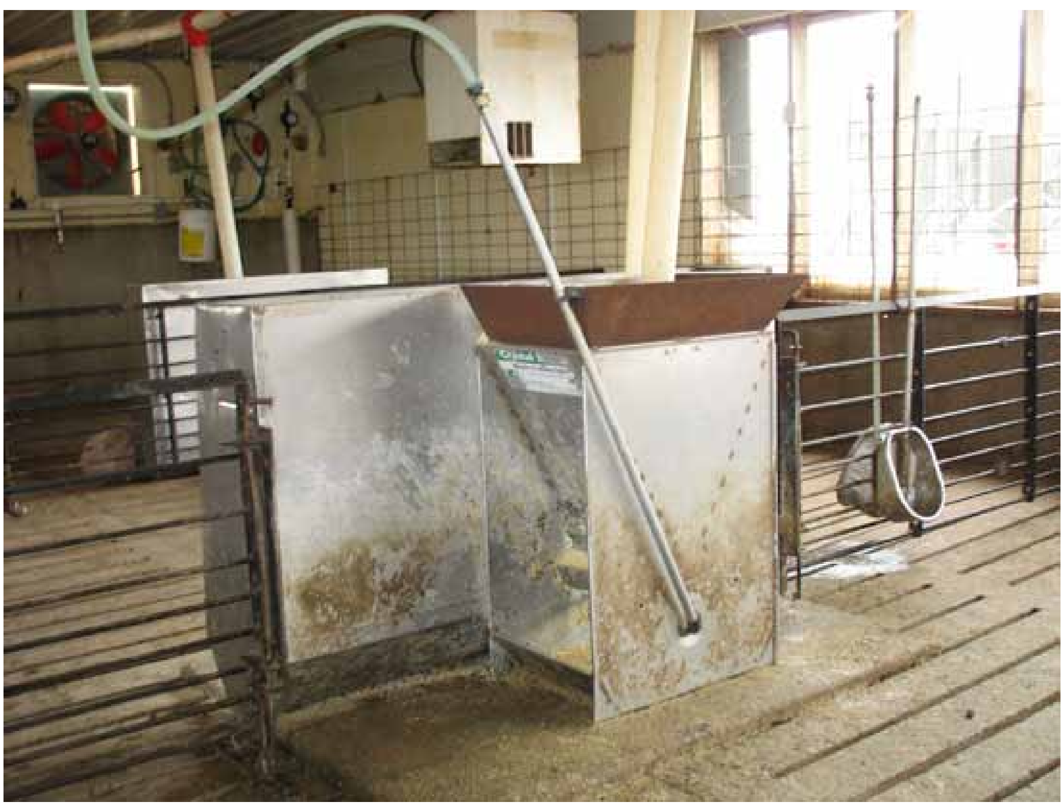

Figure 2. Wet-dry feeder.