Effects of Feed-Withdrawal Time on Finishing-Pig Carcass Characteristics and Economics in a Commercial Environment[1,2]

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Summary

The effects of feed-withdrawal time on finishing-pig carcass composition and net returns were determined in 2 studies. In Exp. 1, a total of 728 pigs (BW = 286.4 ± 2.7 lb, 10 to 19 pigs per pen) were marketed from 48 pens that were randomly assigned to 1 of 4 treatments: feed withdrawal times of 7, 24, 36, or 48 h before harvest. Pigs were fed a common corn-soybean meal diet containing dried distillers grains with solubles (DDGS) and bakery co-products. As expected, increased feed withdrawal time decreased (linear; $P < 0.001$) live weight. Withholding feed also decreased (linear; $P < 0.03$) HCW and backfat depth. Percentage yield increased (quadratic; $P < 0.01$) with longer withdrawal periods, as did percentage lean (linear; $P < 0.01$). Withholding feed increased (quadratic; $P < 0.01$) live price and, accordingly, also increased (linear; $P < 0.001$) carcass price. These results were due in part to increased (linear; $P < 0.02$) premiums and decreased (linear; $P < 0.01$) weight discounts. Total value and net revenue received were similar ($P > 0.32$) between treatments as HCW decreased in fasted pigs, but feed intake per pig also decreased (quadratic; $P < 0.001$), resulting in feed savings of up to $0.78/pig. Withholding feed for 24 h resulted in a numeric increase in net revenue of $0.89/pig compared to 7 h.

In Exp. 2, the 48-h treatment was removed and replaced with a 12-h treatment in order to more accurately determine the proper time to implement feed withdrawal. The incidence of runny bung and leaking ingesta were also recorded to determine whether a relationship existed between feed withdrawal and the incidence of these processing concerns. A total of 843 pigs (BW = 273.0 lb, 16 to 26 pigs per pen) were assigned to 1 of 4 treatments: withholding feed for 7, 12, 24, or 36 h before harvest. Pigs were fed a common corn-soybean meal-based diet containing 20% DDGS. As a result of misidentification of pigs by plant personnel, data were analyzed from only 25 of the original 40 pens. Withholding feed tended to decrease (linear; $P < 0.09$) live weight. Unlike Exp. 1, there were no differences ($P > 0.22$) in HCW, percentage lean, or backfat depth across treatments. However, as in Exp.1, percentage yield (linear; $P < 0.001$) increased with increasing withdrawal time. Although withholding feed had no effect ($P > 0.31$) on the incidence of runny bung, it did increase (linear; $P < 0.001$) the incidence of

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leaking ingesta. For economics, as in Exp. 1, withholding feed increased (linear; $P < 0.002$) live price. Additionally, pigs that were fasted had increased (quadratic; $P < 0.05$) carcass price. Although premiums were similar ($P > 0.32$) across treatments, withholding feed decreased (quadratic; $P < 0.04$) weight discounts. Total value and net revenue received per pig were similar ($P > 0.88$) across treatments, but withholding feed decreased (linear; $P < 0.001$) feed intake, resulting in feed savings of up to $0.46/pig. Overall, withholding feed can be used to avoid weight discounts in heavyweight pigs without negatively impacting carcass composition and maintaining overall revenue per pig. However, these advantages come with a potential reduction in carcass weight and increased incidence of leaking ingesta, which can result in condemned heads at inspection and losses of $3 to 4 per carcass.

Key words: carcass, fasting, feed withdrawal

Introduction

Pigs experience a period of feed withdrawal prior to slaughter for multiple reasons. First, all pigs are subjected to a period of restricted feed access during transport to and lairage time within the harvesting facility. In the early 1980s, a survey of five slaughter plants (Warriss and Bevis, 1986[5]) found that lairage times could range from less than 1 h to more than 20 h. Additionally, withdrawing feed before slaughter reduces the risk of lacerating the gastrointestinal tract during evisceration and decreases the overall drop weight of the tract, thus increasing warm carcass yield. Several studies have also demonstrated that fasting before slaughter reduces the incidence of PSE pork (Murray & Jones, 1994[6]). Fasting pigs for up to 24 h before slaughter results in significant feed savings with minimal effects on carcass weight and pork quality (Kephart and Mills 2005[7]). Feed withdrawal can also be implemented as a means of reducing average pig weight per truckload in order to avoid penalties for heavyweight loads at the slaughter plant, as was the case in these experiments (JBS Worthington, MN; penalty incurred when mean live BW > 280 lb). However, fasting for 24 h or longer reduces hot carcass weight and thus reduces overall carcass value (Kephart and Mills, 2005[5]). Industry reports have also raised concern regarding an association between feed withdrawal and the incidence of runny bung (leaking of fecal matter onto the carcass) or leaking ingesta (stomach contents leaking out of the mouth after shackling). The incidence of these events causes increased food safety risk from carcass contamination and leads to loss in carcass value. For example, leaking ingesta leads to an increased occurrence of condemned heads, which have an approximate value of $3 to 4 per carcass. It is hypothesized that these events occur in greater frequency with fasted pigs because they are more likely to drink a large volume of water in lairage, thus changing the stomach contents to a more liquid form. However, more data are necessary to determine whether a true relationship exists between fasted pigs and the prevalence of runny bung and leaking ingesta.

[5] Warriss, P. D. and E. A. Bevis. 1986. Transport and lairage times in British slaughter pigs. British Veterinary Journal.142:124-130.

[6] Murray, A. C., and S. D. Jones. 1994. The effect of mixing, feed restriction and genotype with respect to stress susceptibility on pork carcass and meat quality. Can. J. Anim. Sci. 74:587-594.

[7] Kephart, K. B. and E. W. Mills. 2005. Effect of withholding feed from swine before slaughter on carcass and viscera weights and meat quality. J. Anim. Sci. 83: 715-721.

Therefore the objective of these studies was to examine the effects of feed withdrawal before slaughter on carcass composition, feed savings, and overall revenue.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. Both experiments were conducted in a commercial research-finishing barn in southwestern Minnesota.

The barns were naturally ventilated and double-curtain sided. Pens had completely slatted flooring and deep pits for manure storage. Each pen was equipped with a 5-hole stainless steel dry self-feeder and a cup waterer for ad libitum access to feed and water. Daily feed additions to each pen were accomplished through a robotic feeding system (FeedPro; Feedlogic Corp., Willmar, MN) capable of providing and measuring feed amounts by pen.

Exp. 1

A total of 728 pigs (PIC 337 × 1050 and initially 286.4 ± 2.7 lb BW) were used with 10 to 19 pigs per pen and 12 replicate pens per treatment in a randomized design. Pens were ranked by mean pig weight and then allotted to each of 48 pens, with pigs per pen and location within the barn balanced across treatment. Pens were mixed gender and had ad libitum access to water throughout the experiment. A common complete diet containing 4.5 g/ton ractopamine HCl (RAC; Paylean, Elanco Animal Health, Greenfield, IN) was fed throughout the experiment. The corn-soybean meal-based diet contained dried distillers grains with solubles (DDGS) and bakery co-products. Before allotment, the heaviest pigs and underweight or cull pigs were removed from each pen according to the farm's normal marketing procedure.

Experimental treatments were designed to reflect the amount of time that pigs had feed removed prior to exsanguination. The four treatments were: (1) feed access up until point of loading on the day of slaughter (7 h), (2) 24-h feed withdrawal, (3) 36-h feed withdrawal, and (4) 48-h feed withdrawal. Pigs were initially weighed by pen at 52 h before exsanguination to allow time for allotment before the application of the 48-h treatment. At this time, feed amounts in each feeder were recorded. The FeedPro system recorded any additional feed delivered to each pen during the experiment. When treatments were applied, feeders were shut off, cleaned, and remaining feed recorded for calculation of feed intake during the test period. Pigs were weighed by pen immediately before loading.

To eliminate transportation effects, the 3 trucks were loaded so each truck included a balanced number of pens. Duration from the beginning of load-out, which started at 0900, until the first pig was exsanguinated was approximately 7 h. This included approximately 3 h for load-out and transit and approximately 4 h of lairage (exact times were not recorded). Upon arrival at the slaughter plant, pigs were again weighed by pen, and transport shrink was calculated. During lairage, pigs had access to water but not feed.

Exp. 2

A total of 843 pigs (PIC 337 × 1050, initially 273.0 lb BW) were used, with 16 to 26 pigs per pen (mixed gender) and 10 replicate pens per treatment in a randomized design. Pens were ranked by mean pig weight and pigs were allotted to each of 40 pens, with pigs per pen and location within the barn balanced across treatment. Before allotment, the heaviest pigs and underweight or cull pigs were removed from each pen. A common complete diet containing 4.5 g/ton ractopamine HCl (RAC; Paylean, Elanco Animal Health, Greenfield, IN) was fed throughout the experiment. The corn-soybean meal-based diet contained 20% dried distillers grains with solubles (DDGS). Ad libitum access to water was provided.

Based on results from Exp. 1, the 48-h treatment was removed due to negative effects on hot carcass weight. That treatment was replaced with feed removed for 12 h before slaughter to more accurately assess the effects of shorter-term feed withdrawal. Additionally, the prevalence of runny bung and leaking ingesta also were recorded.

Four experimental treatments were used: (1) control (7 h), (2) 12-h feed withdrawal, (3) 24-h feed withdrawal, and (4) 36-h feed withdrawal. Pigs were initially weighed by pen 42 h before exsanguination to allow time for allotment before the application of the 36-h treatment. Feed intake was measured as described in Exp. 1.

To eliminate transportation effects, the 4 trucks were loaded so each truck included a balanced number of pens. Load-out began at 0300 and concluded at approximately 0500, with all trucks arriving at the plant before 0800. Actual time when the first pig was exsanguinated was 1205. Mean time between load-out and slaughter was 7 h across treatments. Upon arrival at the slaughter plant, pigs were again weighed by pen. During lairage, pigs had access to water but not feed.

In both experiments, optical probe data (Fat-O-Meater, SFK Technology, Inc., Cedar Rapids, IA), HCW, and payment values including premiums and discounts were recorded on a per-pen basis. Net revenue per pig was calculated based on total value per carcass minus the cost of feed consumed from allotment until slaughter. In Exp. 2, the incidence of runny bung and leaking ingesta was recorded by JBS personnel at the inspection station on a per-pig basis, and then calculated and recorded as overall percentage prevalence per pen.

In both experiments, data were analyzed as a completely randomized design using the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Hot carcass weight was used as a covariate for fat depth, loin depth, and lean percentage. Means were evaluated using linear and quadratic CONTRAST statements in SAS. The coefficients for the unequally spaced linear and quadratic contrasts were derived using the PROC IML procedure in SAS. Least square means were calculated for each independent variable. Results were considered to be significant if P-values were ≤ 0.05 and considered to be a trend if P-values were ≤ 0.10.

Results and Discussion

Exp. 1

As expected, pigs subjected to longer withdrawal times had decreased live weight at load-out (linear; $P < 0.001$) and at the abattoir (linear; $P < 0.001$, Table 1). In terms of carcass characteristics, pigs that had fasted for longer periods had lighter (linear; $P < 0.02$) HCW than pigs treated with normal transit and lairage times. Increased withdrawal time also increased (quadratic; $P < 0.01$) dressing yield. These results agree with studies by Beattie et al. (2002[8]), reporting an increase in dressing yield (from 75.4% to 77.3%) with longer fasting intervals (from 0 to 20 h) resulting from decreased gut fill and offal weight. Longer withdrawal periods also increased percentage lean (linear; $P < 0.01$), decreased (linear; $P < 0.03$) backfat depth, and had no effect ($P > 0.35$) on loin depth.

Withholding feed increased live (quadratic, $P < 0.01$) price up to $2.34/cwt. Carcass price also increased (linear; $P < 0.001$) in fasted pigs, resulting in up to $1.27/cwt greater returns compared to pigs with feed access until load-out. Pigs withheld from feed also received more premiums (linear; $P < 0.02$) and less sort loss discounts (linear; $P < 0.01$) at JBS Swift and Company (Worthington, MN). However, there was no effect ($P > 0.32$) on total value received per pig because of the reduction in live and HCW in pigs fasted longer than 24 h. Withholding feed decreased (quadratic; $P < 0.001$) feed intake per pig marketed, resulting in savings of up to $0.78 per pig. However, these feed savings did not translate into an effect ($P > 0.55$) on net revenue received per pig. Withholding feed for 24 h resulted in a numeric increase in net revenue of $0.89/pig, and pigs fasted for 36 h received only $0.04 less per pig than those with feed access up until loading. These results imply that withholding feed before slaughter can be implemented in order to successfully avoid sort loss discounts and improve premiums received on the rail. However, fasting for 48 h before harvest resulted in a loss of $0.75/pig compared to pigs with full access to feed until load-out, which suggests that the ideal fasting time rests somewhere between 7 and 36 h before slaughter.

Exp. 2

In order to more accurately determine the optimal time to implement feed withdrawal, a 12-h treatment was added to Exp. 2 (Table 2). Due to the significant decrease in HCW and numerically lower economic returns seen in the 48-h treatment during Exp. 1, this treatment was not included in Exp. 2.

Although 843 pigs and 10 replicate pens per treatment were initially allotted to this experiment, data were recovered from only 25 pens (543 pigs, initially 276.0 ± 3.3 lb BW) as a result of pig misidentification by plant personnel. Of the original 10 replicates per treatment, we were able to utilize 7 pens from the 7-h control group, 7 pens from the 12-h treatment, 6 pens from the 24-h group, and 5 pens from the 36-h treatment. Therefore, the on-farm live weight and feed intake data are reported for the 25 pens where carcass data were obtained.

[8] Beattie, V. E., Burrows, M. S., Moss, B. W., and Weatherup, R. N.(2002). The effect of food deprivation prior to slaughter on performance, behavior and meat quality. Meat Science, 62, 413-418.

There were no differences ($P > 0.34$) in live weight across treatment for the remaining pens at allotment, although the 7-h control pigs averaged 5.0 lb lighter than pigs with the 24-h feed withdrawal treatment. As in Exp. 1, increased duration of feed withdrawal tended to decrease (linear; $P < 0.09$) live weights at load-out and upon arrival at the abattoir. However, in contrast to results seen in Exp. 1, there were no differences ($P > 0.44$) in HCW, percentage lean, or backfat depth with longer periods of feed withdrawal. Withholding feed increased (linear; $P < 0.001$) percentage yield over time. As in Exp. 1, there were no differences ($P > 0.34$) in loin depth with feed withdrawal.

The prevalence of runny bung within each pen was similar ($P > 0.31$) across all treatments. However, the prevalence of leaking ingesta within each pen increased (linear; $P < 0.001$) with longer periods of feed withdrawal. This was most evident in the 36-h treatment, where 19.5% of pigs within each pen exhibited leaking ingesta. This rate is a concern, because visible leaking ingesta is a major criterion for head condemnation and results in a loss of approximately $3 to 4 per carcass.

In terms of economics, longer periods of feed withdrawal increased (linear, $P < 0.002$) live price. Carcass price also increased (quadratic; $P < 0.05$) when pigs were fasted. Unlike Exp. 1, the amount of premium received was similar ($P > 0.32$) across treatments. However, there was a decrease (quadratic; $P < 0.04$) in sort loss discounts with longer fasting periods. As expected, feed intake per pig marketed decreased (linear; $P < 0.001$) with longer periods of feed withdrawal, resulting in feed savings of up to $0.46/pig. Nonetheless, there were no differences ($P > 0.88$) in net revenue received per pig across treatments. However, withholding feed between 12 and 36 h before slaughter numerically improved net revenue between $0.69 and $0.83/pig.

After the recovered data were analyzed in Exp 2, there were greater differences in initial BW than desired. Because the control group had a lighter initial BW, they most likely avoided a portion of the sort loss discounts that the control group had received in Exp. 1. This would explain the quadratic response seen in carcass price and sort loss discounts where there had been a strong linear response in both variables in Exp. 1.

In conclusion, both experiments demonstrated that feed withdrawal can be utilized as an effective means of managing heavyweight market hogs in order to avoid sort loss discounts at the abattoir without negatively affecting carcass composition. Additionally, withholding feed may be a useful tool to improve live and carcass price and recover more value, depending on the pricing matrix used at the plant. However, the increased prevalence of leaking ingesta in fasted pigs may offset the processing advantages associated with feed withdrawal and limit packer acceptance.

Table 1. Effects of feed withdrawal on finishing pig performance and carcass traits in a commercial environment (Exp. 1)[1]

	Treatment, h[2]					Probability, $P <$	
Item	7	24	36	48	SEM	Linear	Quadratic
BW, lb							
d 0 (48 hr before marketing)	286.3	285.8	286.8	286.2	2.727	0.94	0.92
d 2 (Wt on farm, lb)	288.9	283.6	276.5	274.2	2.473	0.001	0.19
d 2 (Wt at plant, lb)	283.8	276.8	270.7	268.7	2.448	0.001	0.11
HCW, lb	211.3	210.6	206.7	205.3	1.966	0.02	0.73
Yield, %	74.43	76.09	76.35	76.40	0.231	0.001	0.01
Lean, %[3]	50.63	50.85	51.03	51.09	0.110	0.01	0.26
Fat depth, in[3]	0.67	0.65	0.64	0.63	0.009	0.03	0.26
Loin depth, in[3]	2.49	2.51	2.51	2.53	0.023	0.35	0.96
Economics[4]							
Live price, $	51.43	52.94	53.66	53.77	0.282	0.001	0.01
HCW price, $	69.10	69.58	70.29	70.37	0.281	0.001	0.19
Premiums, $	2.74	3.02	3.18	3.26	0.151	0.02	0.36
Sort loss, $	-1.45	-1.25	-0.71	-0.70	0.206	0.01	0.27
Total value/pig, $	145.99	146.48	145.29	144.47	1.401	0.32	0.83
Feed intake/pig marketed, lb	13.79	8.11	4.14	2.69	0.431	0.001	0.001
Feed cost/pig, $	0.97	0.57	0.29	0.19	0.030	0.001	0.001
Net revenue/pig, $[5]	145.03	145.92	144.99	144.28	1.406	0.55	0.72

[1] A total of 728 pigs (initially 286.4 ± 2.7 lb BW) were used with 12 replicate pens/treatment and averaging 15 pigs/pen.
[2] Treatments reflect actual time feed was withheld before slaughter. 7-hr treatment served as control.
[3] Adjusted with HCW as a covariate.
[4] Reflect actual values received at JBS Swift (Worthington, MN). Live and HCW price based off of base prices of $50.18/cwt and $67.81/cwt, respectively.
[5] Net revenue = (HCW x HCW price) - (Feed intake/pig marketed x $0.07/lb)

Table 2. Effects of feed withdrawal on finishing pig performance and carcass traits in a commercial environment (Exp. 2)[1]

	Treatment, h[2]					Probability, $P <$	
Item	7	12	24	36	SEM	Linear	Quadratic
BW, lb							
d 0 (48 hr prior to marketing)	274.1	277.9	279.1	275.7	3.455	0.84	0.34
d 2 (Wt on farm, lb)	274.5	277.7	274.6	266.9	3.379	0.09	0.26
d 2 (Wt at plant, lb)	268.2	271.1	267.6	260.9	3.135	0.07	0.30
Weight change, lb	-5.9	-6.8	-11.5	-14.9	0.760	0.001	0.001
HCW, lb	202.0	204.7	203.8	200.8	2.899	0.65	0.44
Yield, %	75.21	75.47	76.04	77.00	0.298	0.001	0.55
Lean, %[3]	53.28	53.25	53.18	53.83	0.280	0.22	0.30
Fat depth, in[3]	0.80	0.78	0.80	0.77	0.015	0.51	0.49
Loin depth, in[3]	2.24	2.24	2.21	2.29	0.038	0.47	0.34
Runny bung, % prevalence/pen	3.34	1.24	6.06	5.12	2.196	0.31	0.78
Leaking ingesta, % prevalence/pen	3.34	4.62	9.52	19.52	2.689	0.001	0.36
Economics[4]							
Live price, $/cwt	53.36	53.09	53.66	55.00	0.351	0.002	0.13
Carcass price, $/cwt	70.89	70.31	70.46	71.47	0.303	0.12	0.05
Premiums, $/cwt	0.77	0.73	0.62	1.08	0.229	0.41	0.32
Sort loss, $cwt	-0.69	-1.23	-0.97	-0.42	0.190	0.14	0.04
Total value/pig, $	143.20	143.97	143.61	143.49	2.296	0.99	0.90
Feed Intake/pig marketed, lb	7.80	6.93	3.93	1.28	0.247	0.001	0.93
Feed cost/pig, $	0.55	0.49	0.28	0.09	0.017	0.001	0.001
Net revenue/pig, $[5]	142.7	143.48	143.34	143.40	2.297	0.88	0.90

[1] Of the 40 pens (843 pigs) initially allotted to this experiment, only 25 pens (543 pigs initially 276.0 ± 3.3 lb BW) were utilized as a result of data lost at the plant. Number of observations: 7 h (7 pens); 12 h (7 pens); 24 h (6 pens); 36 h (5 pens).
[2] Treatments reflect actual time feed was withheld before slaughter. 7-h treatment served as control.
[3] Adjusted with HCW as a covariate.
[4] Reflect actual values received at JBS Swift (Worthington, MN). Live and HCW price based off of base prices of $52.40/cwt and $70.81/cwt, respectively.
[5] Net revenue = (HCW x HCW price) - (Feed intake/pig marketed x $0.07/lb)