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Evaluation of the effect of errors in the sorting of pigs for market on financial loss at a range of marketing ages

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ABSTRACT

The BW growth curves for twenty-five 4,000-head finishing barns were simulated to evaluate the effect of 2 types of market pig sorting errors on the sort loss at different mean carcass weights (CW). Two types of errors were evaluated: BW estimation error (BWEE) and percentage of pigs not visually evaluated (PNVE). Four levels of BWEE with SD of 0, 4, 6, and 8% of BW and 4 levels of PNVE (0, 8, 16, and 24%) were simulated. Sort loss was calculated using a market value system for a United States pork processor. Pigs were initially marketed in 3 marketing cuts, 25% at 169, 25% at 179, and the remaining 50% at 193 d of age. Then the marketing ages for the pigs were shifted in weekly intervals with mean ages of 155.5 to 211.5 d. The number of pigs with sort loss and mean sort loss per pig were fitted to a model including the fixed effects of level of marketing age (AGE), BWEE, PNVE, and their interactions and random effect of replicate barn. The effects of AGE, BWEE, and PNVE, and AGE × PNVE, AGE × BWEE, and AGE × BWEE × PNVE interactions affected both variables ($P < 0.001$). Sort loss increased more rapidly with increased CW at higher levels of BWEE and PNVE ($P < 0.001$). The effect of sorting accuracy on financial loss is dependent on the CW. The effects of sorting accuracy and interactions with CW must be considered in the evaluation of alternative marketing strategies.

Key words: pork, marketing, sort loss, stochastic model, pig supply chain

INTRODUCTION

Pig marketing grids have been established in which carcasses heavier or lighter than a specified carcass weight (**CW**) range are discounted in value. Most commercial pork producers visually evaluate the BW of each pig and try to identify the heaviest pigs for marketing on multiple marketing days to reduce CW discounts, traditionally called sort loss, and target the optimal market BW (Li et al., 2003; Boys et al., 2007; Flohr et al., 2015). On large farms, pig sorting-marketing crews target a specific number of heavy pigs in each pen to be marketed each marketing day (McBride and Key, 2003).

Errors in the visual assessment each pig's BW result in marketing errors (Ahlschwede and Jones, 1992). In large pens, the sorting-marketing crew may identify the target number of pigs for marketing (i.e., 25%, 32 out of 125) before visually evaluating all the pigs in the pen. Thus, 2 types of pig marketing errors exist: errors in the estimation of BW for the pigs that are visually evaluated and the percentage of pigs that are not visually evaluated (Cabezon et al., 2016).

When the actual CW and sort loss data were evaluated for 3 large wean–finish barns, a barn with the greatest mean CW, close to the upper acceptable CW, had much greater mean sort loss than the other 2 barns at the same approximate sorting accuracy (Que et al., 2016). Inaccurately sorted pigs with a mean CW close to the mean of the upper and lower acceptable nondiscounted CW had only an estimated $1.00/pig increase in sort loss in comparison with sorting with no error (Cabezon et al., 2016). The previous results suggest that the effect of inaccurate sorting on sort loss may be substantially affected by the mean CW of pigs marketed. The effect of sorting errors on sort loss at different marketing ages and mean CW has not been evaluated. The objectives of this study were to use simulated data to (1) evaluate the effect of 2 types of market pig sorting errors on the sort loss at different mean CW, and (2) demonstrate that the magnitude of sort loss due to inaccurate sorting is affected by the mean CW of the pigs marketed.

MATERIALS AND METHODS

The simulation methods used to develop the data are discussed in detail in Cabezon et al. (2016). The BW growth curves for twenty-five 4,000-head wean-to-finish barns were simulated. The BW data were simulated using a Michaelis-Menten equation with addition of pig-specific random effects to produce variation in BW. The pig growth, feed intake, and carcass percent lean data were

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modeled from previous data (Schinckel et al., 2012a,b). A marketing strategy was simulated to represent that currently used by pork producers with 3 marketing cuts (**MCUT**). Twenty-five percent of the pigs were targeted to be marketed at 169 d, 25% at 179 d, and the remaining pigs marketed at 193 d of age. In this trial, the pigs were simulated to be marketed at different weekly times with mean ages of 155.2, 162.5, 169.5, 176.5, 183.5, 190.5, 197.5, 204.5, and 211.5 d of age. Weekly, the same pigs with same sorting errors were modeled to be marketed with the same percentages in each MCUT and time intervals between each MCUT.

Four BW assessment error rates (**BWEE**) were simulated to represent zero, low, average, and high levels of visual assessment of BW (Ahlschwede and Jones, 1992). The BW assessment errors were simulated to have SD of 0, 4, 6, and 8% of each pig's actual BW (Cabezon et al., 2016). Each pig was randomly assigned to be evaluated or not for BW. The percentages of pigs with their BW not visually assessed (**PNVE**) were 0, 8, 16, and 24%. These values are based on the inspection of carcass data obtained from several 4,000-head barns with 3 marketing cuts per barn (Que et al., 2016; Y. Que and A. P. Schinckel, unpublished data).

The 4 levels of visual assessment accuracy (BWEE with SD of 0, 4, 6, and 8% of BW) and 4 levels for the percentage of pigs not visually evaluated (PNVE, 0, 8, 16, and 24%) were applied to each of the 25 barns as a factorial arrangement of treatments. Thus, each of the 25 barns was modeled to have 16 combinations of the 2 types of market BW sorting errors.

Sort loss was calculated using a market value system for a midwestern United States pork processor (Indiana Packers Corporation, 2015, Table 1). The total amount and mean sort loss per pig were estimated for each MCUT and the entire barn. Three variables, number of pigs with sort loss, mean sort loss per pig in the barn, and mean sort loss for pigs with sort loss, were fitted to a model including the fixed effects of level of marketing age (**AGE**), BWEE, PNVE, and their interactions and random effect of replicate barn, using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC). Barn was considered as a repeated measurement over age with a compound symmetry covariance structure. The SLICE option of SAS was used to evaluate the significance of BWEE, PNVE, and the interaction of BWEE × PNVE for each AGE.

RESULTS AND DISCUSSION

The BW and CW at the mean age for each weekly marketing time are presented in Table 2. The SD for both BW and CW were modeled to increase with age. The mean CW were modeled over a range that were just below the pork processors lower acceptable CW (82.1 kg) and above upper acceptable CW (107.0 kg).

The means for the mean sort loss per pig in the barn are shown in Figures 1 to 3. The means for 4 levels of sorting accuracy (BWEE = 0%, PNVE = 0%; BWEE = 8%, PNVE = 0%; BWEE = 0%, PNVE = 24%; and BWEE = 8%, PNVE = 24%) are shown in Table 3. The main effects of AGE, BWEE, and PNVE, and AGE × PNVE, AGE × BWEE, and AGE × BWEE × PNVE interactions affected ($P < 0.001$) the mean sort loss per pig. The effects of BWEE and interaction of BWEE × PNVE affected ($P < 0.001$) the mean sort loss per pig at all ages. The PNVE affected the sort loss at all ages ($P < 0.001$) except a mean AGE of 162.5 d. The CW at minimal mean sort loss was 93.17 kg for accurate sorting ($0.79, 183.5 d, BWEE = 0% and PNVE = 0%). With less accurate sorting, the minimal sort loss of $1.72/pig was achieved at a mean age of 176.5 d at 89.53 kg (BWEE = 8% and PNVE = 24%). As CW or mean age at marketing increased, the sort loss for the pigs with greater sorting errors had increasingly greater sort loss. The sort loss per pig increased from $0.91 at 187 d mean age at marketing to $5.63 at 201 d for accurate sorting (BWEE = 0% and PNVE = 0%), and

Table 1. Discount rates for different carcass weight classes[1]

Carcass weight, kg	Discount, $/kg
<68.5	0.441
68.5–73.0	0.286
73.0–75.3	0.176
75.3–77.6	0.121
77.6–82.1	0.77
82.1–107.0	0
107.0–109.3	0.0661
109.3–111.6	0.2425
111.6–113.9	0.2866
113.9–116.1	0.3307
>116.1	0.3748

[1]Indiana Packers Corporation (2015).

Table 2. Mean and SD of overall BW and carcass weight (CW) at a range of marketing ages with accurate sorting

	BW		CW	
Mean age, d	Mean, kg	SD	Mean, kg	SD
155.5	104.67	6.67	75.49	5.07
162.5	111.01	7.07	80.09	5.38
169.5	117.20	7.47	84.58	5.68
176.5	123.21	7.85	88.95	5.97
183.5	129.03	8.22	93.17	6.26
190.5	134.65	8.58	97.26	6.53
197.5	140.08	8.92	101.21	6.80
204.5	145.30	9.26	105.00	7.05
211.5	150.32	9.58	108.65	7.30