Published April 25, 2019

2018 Reciprocal Meat Conference – Meat and Poultry Quality

Meat and Muscle Biology™

Effect of Hot Carcass Weight on the Rate of Temperature Decline of the Longissimus Dorsi and Semimembranosus of Pigs Slaughtered in a Blast-Chilled Commercial Abattoir

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Keywords: autocorrelation, chilling, ham, loin, modeling
Meat and Muscle Biology 2(2):109 **doi:10.221751/rmc2018.098**

Objectives

Over the last 30 yr, the average hot carcass weight (HCW) has consistently increased by approximately 0.5 kg per yr. This trend toward increased HCW causes engineering challenges for aging facilities designed when average HCW was 85 kg, in contrasts to today's average HCW of 95 kg. The rate of carcass chilling is among the primary concerns. Larger carcasses have a smaller surface area to volume ratio, and almost certainly do not reach desired internal temperatures at the same rate as smaller carcasses. However, differences in rate have not been routinely reported, and to the authors' knowledge, no such model has been reported for a large-scale, blast-chilled pork abattoir. Therefore, the objective of this study was to model the effect of HCW on temperature decline of a contemporary population of pork carcasses slaughtered at a commercial abattoir that used a blast-chilling method. Additionally, carcasses were sorted into HCW classes and the effect of HCW group was tested on the rate of temperature decline of the longissimus dorsi and semimembranosus.

Materials and Methods

Hot carcass weight, internal temperature of the loin muscle (at the 10th rib) and ham, as well as ambient temperature, were recorded from 40 to 1,320 min postmortem (45 time points) on 754 pork carcasses. An exponential decay model based on Newton's Law of Cooling, was fit to temperature decline of the ham and loin of the whole population using PROC MODEL of SAS (SAS Inst. Inc., Cary, NC). The initial models for the decline of both ham and loin temperature displayed significant autocorrelation of errors based on evaluation of the autocorrelation function plots and Durbin-Watson test ($P < 0.0001$). Therefore, second and third order autocorrelation parameters were tested. Based on Durbin-Watson tests, the use of second order autocorrelation model with lags of 1 and 2 were deemed adequate and were therefore included in all subsequent models. This base model and its respective parameter estimates were all significant ($P < 0.01$) for the whole population. Carcasses approximating (± 1 kg) 85, 90, 95, 100, and 105 kg were selected and binned into their respective weight classes. Dummy variables were used to compare the effect of HCW class on parameter estimate of ham and loin models.

Results

The developed model significantly fit all weight classes ($P < 0.01$) for both ham and loin temperature decline. For both loin and ham models, estimates of the rate constant (k) generally decreased as HCW increased. For loin temperature, k estimate for 105 kg carcasses was 0.00124 less ($P = 0.02$) than 85 kg carcasses, with the intermediate HCW classes not differing from the 85 kg class. For ham temperature, estimates of k for 90, 95, 100, and 105 kg HCW were all significantly and successively less than the k estimate for 85 kg class. For perspective, loins of 95 kg carcasses were estimated to reach 2°C in 17 h; whereas, loins from 105 kg carcasses would not reach 2°C until 27 h. For hams, 95 kg carcasses were projected to reach 2°C in 21 h; whereas, those from 105 kg carcasses would take 28 h. These estimates generally agreed with observed values.

Conclusion

Overall, HCW significantly affects the rate of temperature decline of pork hams, but not loins from pork carcasses weighing between 85 and 100 kg. This method of analysis can be used to model temperature decline in individual facilities.

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