A technique for predicting water-holding capacity in early postmortem muscle

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ABSTRACT

Current methodologies for determining water-holding capacity, a primary determinate of pork quality, are time-consuming. Therefore, this study was designed to develop a rapid, inexpensive technique for predicting water-holding capacity early postmortem. Twenty hogs were harvested and carcasses were handled to obtain variation in drip loss, a characteristic of water-holding capacity. Cotton-rayon absorptive material was inserted in the longissimus muscle adjacent to either the 12th or 9th rib at various times postmortem (PM). Approximately 2 g of absorptive material was inserted through an incision in the loin. Absorptive material was inserted at 15 min PM and replaced at 15 min intervals until 120 min PM. Material inserted at 120 min remained in the muscle until 1440 min PM. Drip loss measurements of loin chops were determined by the Danish drip tube method and related to individual and accumulated absorption values. Exudate release was greater ($P<0.0001$) at the most anterior position of the longissimus muscle. Individual 15 min absorption values between 60 and 75 min PM were related ($P<0.05$) to drip loss (r=0.48 and 0.54, respectively). Accumulated absorption values (summation of all exudates) were also correlated ($P<0.05$) to drip loss. A greater relationship, however, was observed at the 12th rib (r=0.74) compared to that observed for the location adjacent to the 9th rib (r=0.71). Results from this study suggest that using an absorptive material may be a useful and accurate means of predicting water-holding capacity during the early postmortem period.

INTRODUCTION

Water-holding capacity is the ability of muscle to retain naturally occurring moisture. Current methods used to estimate water-holding capacity of postmortem muscle by means of measuring drip loss are time-consuming (Offer and Trinick, 1983).

Some methods to predict water-holding capacity use gravity, centrifugation, and other external and capillary forces (Honikel, 1998; Rasmussen and Andersson, 1996; Warriss, 2000; Hamm, 1986). Gravitational techniques include the hanging bag method proposed by Honikel (1998) and the Danish drip tube method developed by Rasmussen and Andersson (1996). Both of these methods require that muscle samples be removed at 24 h PM and allowed to "drip" for a given period of time, typically 24 h. Alternatively, centrifugation methods subject meat samples to centrifugal force involving high speeds and gravitational forces. This artificially-induced force results in a supernatant decanted as exudate. The muscle sample is weighed before and after centrifugation to determine the amount of moisture lost and the corresponding water-holding capacity can be predicted (Hamm, 1986; Warriss, 2000).

In addition to the cost of equipment that may be needed, each of these methods are tedious and cumbersome. Therefore, the objective of this study was to develop a rapid, relatively inexpensive technique for predicting water-holding capacity early postmortem.

MATERIALS AND METHODS

Carcasses and loins:

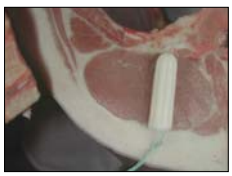
•Experiment 1: Twenty hogs were harvested at the Meat Science Research and Education Center (MSREC) with 12 carcasses electrically stimulated (ES) at 450 volts for 26 pulses at 6 min PM. The remaining eight carcasses were not stimulated (NS).

•Experiment 2: Ninety-two hogs were harvested under normal conditions at MSREC.

pH: Measurements were recorded at 0, 15, 30, 45, 60, 75, 90, 120, and 1440 min (Experiment 1) using a Beckman Φ110 ISFET probe.

Absorption:

•Cotton-rayon material (~2 g; o.b. Regular Absorbency Tampons, Johnson & Johnson) was inserted in the longissimus muscle through the subcutaneous fat layer as shown below.



Material was inserted in "+"-shaped incisions approximately 6 cm deep at the 12th and 9th ribs.

•Absorption was calculated as the difference between the final weight plus exudate and the initial dry weight of the material.

•Experiment 1: Material inserted for 15 min intervals starting at 15 min PM except the last, which was inserted at 120 min PM and remained in the loin until 1440 min PM.

•Experiment 2: Material inserted at 24 h PM and allowed to remain in the carcass for either 15 min or 45 min.

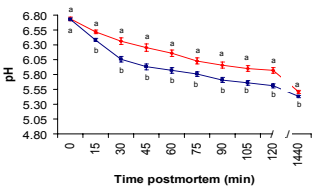
Drip loss:

•Drip loss measurements were determined using the Danish drip tube method described by Rasmussen and Andersen (1996).

•Experiments 1 and 2: A 2.54 cm thick chop was taken from between the two incisions and drip loss was determined in triplicate and duplicate, respectively.

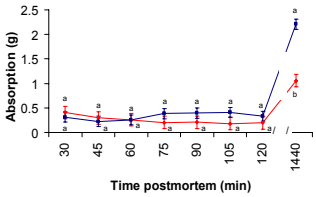
RESULTS AND DISCUSSION

For all linear graphs **NS** (non-stimulated) values are depicted in red and **ES** (electrically stimulated) values are depicted in blue. Decline in pH values for carcasses in Experiment 1 is depicted below showing that ES carcasses have lower pH values than NS carcasses.

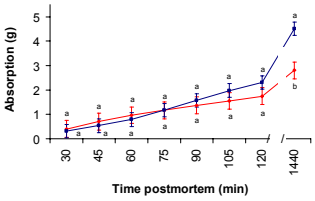


RESULTS AND DISCUSSION

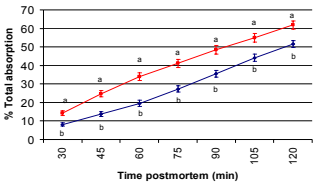
Individual absorption values for Experiment 1 are shown below with ES carcasses absorbing more moisture than NS carcasses.



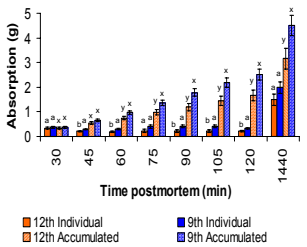
Accumulated absorption values for Experiment 1 reflect the summation of moisture absorbed over time. Again, the ES carcasses absorb more moisture than the NS carcasses at the end of the experiment.



The percent of total accumulated absorption was determined by dividing the accumulated absorption values at each time point by the total absorption at 1440 min PM. NS carcasses absorb a higher percentage (61.8%) of moisture earlier than ES carcasses (51.6%).



The differences between the two locations for individual and accumulated absorption are depicted below. The 9th rib location absorbed more moisture, but a greater relationship exists between absorption values and drip loss at the 12th rib. Comparisons are made between locations for individual and accumulated absorptions.



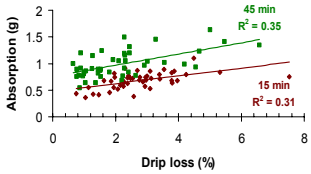
RESULTS AND DISCUSSION

Correlation coefficients (r-values) between individual absorption values and drip loss for each location are shown in the next table.

Time PM	12th Rib	9th Rib
30 min	-	-
45 min	-	-
60 min	-	0.48
75 min	0.54	0.72
90 min	0.61	0.62
105 min	0.78	0.67
120 min	0.75	0.54
1440 min	0.70	0.67

*Significant values ($P<0.05$) are reported.

Relationship between absorption and drip loss for Experiment 2.



CONCLUSIONS

•Greater moisture was absorbed from muscle of electrically stimulated carcasses than that of non-stimulated carcasses.

•Equivalent moisture loss from muscle of electrically stimulated carcasses was delayed ~30 min compared to non-stimulated carcasses.

•Over half (50-60%) of the total accumulated moisture was absorbed within the first 120 min postmortem.

•This technique is a rapid means of predicting water-holding capacity as early as 75 min PM.

•Utilization of a cotton-rayon material may be an alternative means of monitoring muscle moisture release in pork carcasses early postmortem.

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