THE EFFECT OF WATER SPRINKLING ON BLOOD LACTATE AND MEAT QUALITY OF MARKET HOGS TRANSPORTED DURING SUMMER

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Abstract – The objective of this study was to assess the efficiency of water sprinkling (WS) hogs inside a stationary trailer in summer, in terms of stress response and pork quality variation. In each of 12 weeks between May and September, 2011, two pot-belly trailers with 208 hogs were transported to the slaughter plant (2 h transport). One of the two trailers was equipped with a water sprinkling system (WS vs. control, C). Blood lactate levels and meat quality traits were assessed on a sub-sample of randomly selected hogs (n=384/576). Exsanguination lactate levels decreased (*P*=0.02) and pH1 value of the *longissimus dorsi* (LD) muscle increased (*P*=0.009) in WS hogs compared to C, regardless of temperature. WS reduced exsanguination lactate levels in pigs transported in the middle front (C5) and rear (C8) compartments at 15°C (*P*=0.03) and 18°C (*P*=0.009). In C5, the pH1 value in the LD muscle of WS hogs was higher at 18°C (*P*=0.002), and 22°C (*P*<0.001), and drip loss was lower at 22°C (*P*=0.01), and at 25°C (*P*=0.02). The results of this study showed that sprinkling hogs in a stationary vehicle at ambient temperatures greater than 20°C can increase animal welfare and improve pork quality.

Key Words – heat stress, pigs, transportation

I. INTRODUCTION

When a pot-belly (PB) trailer is stationary in the summer, the internal temperatures can quickly exceed the upper limit of the thermoneutral zone for pigs (30°C), with the middle and bottom front compartments being up to 10°C warmer than the external ambient temperature [1]. Furthermore, a higher incidence of pale loins was recorded from pigs transported in the upper and lower decks of a PB trailer in summer [2]. At these ambient conditions, it has been suggested that pigs should be cooled using water sprinkling [3, 4]. However, guidelines on the use of sprinkling systems are based on industry practices and are confusing as they recommend to start sprinkling pigs located in a stationary vehicle at ambient temperatures of either 15 or 27°C [3, 4]. The objective of this study was thus to assess the efficiency of water sprinkling in a stationary PB trailer (both after loading and before unloading), in terms of hog response to heat stress and pork quality variation, and to identify a cut-off ambient temperature to ensure the greatest efficacy of this practice.

II. MATERIALS AND METHODS

Approximately 5,000 crossbred hogs (115±10 kg) were transported from a commercial finishing farm to a slaughter plant (2 h trip) using 2 tri-axle, dual purpose pot-belly (PB) trailers over a 12 week period (a trip or replicate/trailer/week) between June and mid-September, 2011. Both PB trailers used in this study transported 208 hogs on three decks distributed across 10 compartments (4 in the upper and middle decks and 2 in the bottom deck or "belly"; Fig. 1) at a density of 0.40 m^2/100 kg.

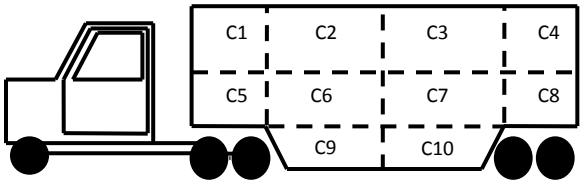

Figure 1. Compartment position inside the Pot-Belly trailer.

Of the two trailers, one was equipped with a sprinkling system (WS; Weeden Environments, Woodstock, Canada), while the other had no sprinkling system installed (control, C). The sprinkling system was operated in the stationary trailer 5 min after loading had concluded, immediately prior to departure from the farm and during the last 5 min of the 30–min wait at the plant, immediately before unloading. During each 5–min sprinkling session a total of 125 litres of water were used. In each replicate (or journey), test pigs were distributed into 4 separate compartments in each trailer, namely C4 (upper rear), C5 (middle front), C8 (middle rear) and C9 (bottom front) (Fig. 1). Loading and unloading order (rotation of decks) were randomized each week in order to avoid the confounding effect of the outside temperature variation and wait time in each deck (or compartment). Six "sentinel" hogs per test compartment were randomly chosen and identified at the farm for the meat quality evaluation. Each group of 6 hogs included 4 "sentinel" hogs randomly selected for the blood lactate study. On arrival at the plant, hogs were driven to separate lairage pens based on the transport compartment (no mixing). After 90 min of lairage, pigs were driven to a CO_2 stunner (Combi 77, Butina, Denmark) and exsanguinated. A blood sample was obtained at exsanguination and lactate levels were immediately measured in duplicate by means of a hand-held lactate analyzer (Lactate Scout Analyzer-LSA, EKF Diagnostic GmbH, Magdeburg, Germany). Muscle pH was measured at 1 and 24 h post-mortem in the *Longissimus dorsi* (LD) muscle by means of a portable pHmeter (Oakton Instruments Model pH 100 Series, Vernon Hills, IL). Other measurements taken at 24 h post-mortem in the LD muscle were: light reflectance by a Minolta Chromameter CR 300 according to the reflectance coordinates (CIE L*, a*, b*) and drip loss according to a modified EZ-DripLoss procedure [5].

Data were analyzed using the MIXED procedure (SAS Inst. Inc., Cary, NC). Ambient temperature during transport (average value between the time of loading and unloading) was used as a covariate and week was used as a random block effect. If no correlation was found between the covariate and the dependant variable, a model without covariate was used and sprinkling was the only effect tested. For the analyses within the compartments, temperature, compartment, sprinkling and their interactions were all kept in the model and tested as fixed effects.

III. RESULTS AND DISCUSSION

Average ambient temperatures during transport ranged from 14.1°C to 25.8 °C.

No interaction was found between ambient temperature and WS on exsanguination lactate levels and pork quality traits.

Overall, in this study exsanguination lactate levels decreased as temperatures increased (P=0.006), and lactate levels were lower (P=0.02) in WS pigs, regardless of the ambient temperature (Fig. 2).

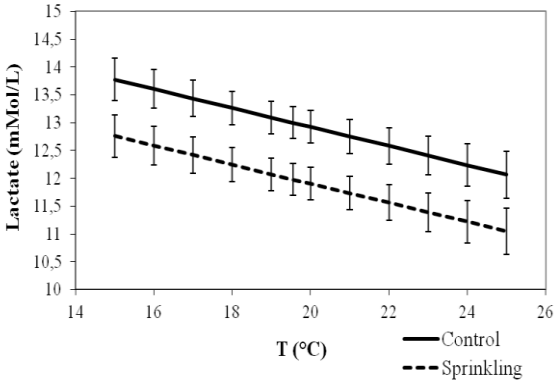

Figure 2. Effect of ambient temperature and water sprinkling on exsanguination lactate levels.

Lower lactate levels have been reported in pigs transported at higher ambient temperatures in a previous study [6] and were associated to a reduced physical activity (increased lying behaviour) due to the need of hogs to minimize muscular heat production at these ambient

conditions [6, 7]. The reduced lactate levels at exsanguination in WS compared with C hogs would indicate their better physical condition (reduced fatigue) at slaughter.

As expected, drip loss values increased as ambient temperatures increased from 15 to 25°C (4.5 to 5.4±0.2%; P=0.004). Except for pH1, which was higher (6.21 vs. 6.14±0.03; P=0.009) in the LD muscle of WS hogs, pork quality traits were unaffected by WS. The positive relationship between exsanguination lactate as measured with the LSA and the rate of early post mortem metabolism (resulting in an inverse relationship between lactate at exsanguination and pH1 was already reported by Edwards et al. [8].

As shown in Fig. 3, the hogs transported in C5 presented lower lactate levels when WS was applied at 15°C and 18°C (P=0.03 and P=0.009, respectively) and showed a trend for lower lactate levels at 22°C (P=0.08). WS also caused reduced lactate levels in hogs transported in C8 at 22°C and 25°C (P=0.03 and P=0.04, respectively).

WS affected pork quality of hogs located in C5, with the pH1 value of the LD muscle being higher at 18°C (6.25 vs. 6.09±0.04; P=0.002), 22°C (6.27 vs. 6.06±0.05; P=0.0005) and 25°C (6.28 vs. 6.04±0.07; P=0.005) and drip loss value decreasing at 22°C (P=0.01) and at 25°C (P=0.02; Fig. 4). Furthermore, a trend for higher pH1 (6.27 vs. 6.17±0.05; P=0.09) was observed in the LD muscle of hogs transported in C8 at 22°C.

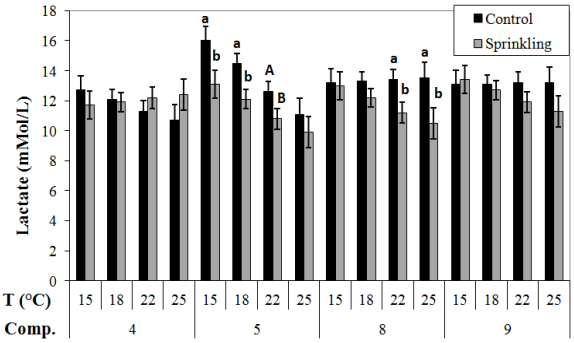

Figure 3. Effect of water sprinkling on exsanguination lactate by trailer compartment (^{ab}P<0.05, ^{AB}P<0.10)

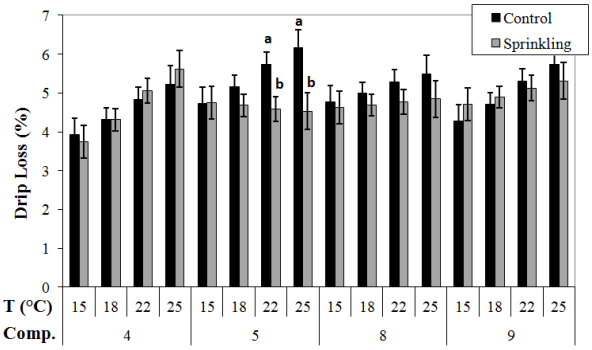

Figure 4. Effect of water sprinkling on drip loss as measured in the LD muscle by trailer compartment (^{ab}P<0.05)

C5 was reported as being the warmest location inside the PB trailer in previous summer transport trials [1]. Higher temperatures in this compartment were explained by reduced ventilation caused by its design (solid front wall) and position, being located immediately behind the tractor and above the tractor drive wheels and drive train, which radiate heat to the exterior of this compartment [1]. Hogs located in C8 were the last to be loaded and left the farm while they were still under the effects of loading stress in this study. This situation resulted in higher body temperature in C8 pigs during transport in previous summer trials [9]. Thus, the practice of water sprinkling appears to improve the comfort of hogs in these critical trailer locations.

IV. CONCLUSION

The results of this study showed that the application of water sprinkling for a short period after loading and before unloading can represent a valuable practice to increase animal welfare and improve pork quality. The efficacy of water sprinkling in a stationary PB trailer appears to increase when applied at ambient temperatures above 20°C.

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