WATER SPRINKLING MARKET PIGS IN A STATIONARY TRAILER PRE- AND POST-TRANSPORT: EFFECTS ON PIG BEHAVIOUR, GASTROINTESTINAL TRACT TEMPERATURE AND TRAILER MICRO-CLIMATE

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ABSTRACT
Pigs are often transported to slaughter under conditions of high temperature and humidity, which can lead to reduced welfare and increased in-transit losses. Water sprinkling in barns is used to control microclimate, resulting in pig body temperature reduction and improved welfare; however there is no clear evidence of these effects during transport. The aim of this study was to observe the effect of sprinkling pigs in trailers on behaviour and body temperature during transport and lairage, as well as to observe the effects on trailer microclimate. The results suggest that sprinkling pigs in a stationary vehicle when ambient temperature exceeds 23°C has the potential to prevent increases in body temperature during short duration transport without detrimental effects on ammonia levels within the trailer or on behaviour during unloading.

BACKGROUND
Transportation is one of the most stressful experiences in a pig’s life, particularly when it occurs during environmental extremes (Ritter et al., 2009). As pigs do not sweat, they are limited in their capacity to control core body temperature in hot environments and are sensitive to heat stress (Bliigh, 1985). In-transit mortality has been reported to increase beyond ambient temperatures of 16-17°C (Warriss and Brown, 1994; Haley et al., 2010) and increase with increasing temperature (Sutherland et al., 2009; Haley et al., 2010). Furthermore, the frequency of heat stress indicators (e.g. panting, skin discoloration) has been shown to increase in warmer months (Ritter et al., 2008). As temperature increases, pigs modify their behaviours in order to reduce heat production and increase heat dissipation by reducing activity (Hicks et al., 1998; Brown-Brandl et al., 2001) and increasing contact with cool or moist surfaces (Hillmann et al., 2004; Huynh et al., 2005). Water sprinkling systems in barns have been shown to increase the evaporative cooling capacity and decrease the temperature-humidity index (Haeussermann et al., 2007), but there are currently few methods available to cool pigs during transport besides natural ventilation. Both active ventilation and water misting in a stationary truck are credited with reducing deaths during transport (Nielsen, 1982; Colleu and Chevillon, 1999). Colleu and Chevillon (1999) found that sprinkling pigs at an ambient temperature above 10°C in one deck of a trailer helped to reduce skin temperature by 10% compared to the non-sprinkled pigs in another deck on the same trailer. However, considering known differences in micro-climate within a trailer.
(Brown et al., 2011; Weschenfelder et al., 2012), the effect of sprinkling pigs within compartments in a trailer needed to be examined.

EXPERIMENTAL DESIGN

The aim of this study was to examine the effect of sprinkling water within full trailers of pigs at the farm before departure and before unloading at the plant on trailer conditions, behaviour and gastrointestinal tract temperature during transport, unloading and lairage. Effects on measures of stress physiology and meat quality are reported in Nannoni et al., 2014.

In each of 12 weeks from May to September 2011, 2 pot-belly trailers with 208 pigs each (n = 4,992) were transported from the same farm on the same day 2 h to slaughter. One trailer was equipped with a custom-built sprinkler system connected to a standard water hose, which ran for 5 min (~125 L) before departure and before unloading, and the other trailer served as the control. In each trailer, 4 compartments were outfitted with cameras, ammonia detectors and temperature/humidity data loggers (Figure 1). The gastrointestinal tract temperature (GTT; °C) of 4 randomly chosen pigs (n = 384) in each test compartment was recorded using orally administered data loggers. Trailer and deck loading order were randomized. Behaviour during transport, unloading and lairage (standing, sitting, lying; slips and falls) was recorded from video or live observations. Data were analyzed through ANOVA with ambient temperature external to the trailer (AmbT) as a covariate. AmbT averaged 19.5°C ± 3.8°C (range: 13.6 to 25.8°C).

Figure 1. Pot-belly trailer compartment designations (1-10); circled numbers indicate test compartments selected for micro-climate data collection and behavioural observations during transport; 4 test pigs in each test compartment were monitored for gastrointestinal tract temperature.

RESULTS AND DISCUSSION

Sprinkled trailers showed lower (7.9 v 8.7°C; P = 0.002) increases in internal compartment temperature from loading to unloading and smaller (~21.5% v ~27.9%; P < 0.001) decreases in humidity. The sprinkling treatment did not affect ammonia levels, which is encouraging as the introduction of water may volatilize components of urine and feces which would be a concern for pigs and handlers. Consistent with Brown et al. (2011) and Weschenfelder et al. (2012), trailer microclimate characteristics were most impacted by compartment, with the back compartments (4 and 8) displaying smaller increases in air temperature than the front compartments (5 and 9). This may be due in part to differences in air flow, since during transport, air flows up and over the trailer.
and enters from the rear, moving towards the front, thereby allowing greater air flow in the rear compartments (Kettlewell et al., 2001).

At AmbT > 23°C, there was no effect of sprinkling on behaviour on the trailer, but at AmbT < 23°C, more pigs stood on sprinkled trailers (Figure 2; $P < 0.05$). It may be that in the sprinkled trailer, the novelty of the sprinkling stimulates activity at ambient temperatures below 23°C, as indicated by pigs spending more time standing and less time lying throughout the duration of transport than in the non-sprinkled trailers.

![Figure 2. The interaction of ambient temperature and sprinkling treatment on proportion of time (LSMEANS; % ± SEM) pigs spent standing during transport (* $P < 0.05$).](image)

The addition of the water to the trailer during sprinkling did not affect slips or falls during unloading. In lairage, latency to rest was reduced as AmbT increased for all compartments (Table 1; $P < 0.05$); sprinkled pigs spent more time lying (Table 1; $P < 0.05$) and had fewer drinking bouts than non-sprinkled pigs (Table 1; $P < 0.001$) regardless of AmbT. The greater time pigs from sprinkled trailers spent lying vs. sitting could be related to the fact that pigs from non-sprinkled trailers performed more drinking bouts, which resulted in pigs spending more time active near the drinkers. As well, pigs from compartment 4 showed the fewest drinking bouts per pig, regardless of treatment (Table 1; $P < 0.001$). The low numbers of drinking bouts by pigs in compartment 4 may be indicative of increased fatigue due to the movement up and down ramps during loading and unloading and this is also reflected in smaller proportions of time spent standing and reduced latency to rest.

GTT increased between loading and departure and decreased during transit for all pigs regardless of treatment (Figure 3; $P < 0.001$); and sprinkling tended to further reduce GTT at arrival at AmbT > 24°C ($P = 0.08$). Due to the negligible impact of ambient temperature or sprinkling treatment at loading and departure, this rise in temperature is likely the primary result of the exercise (D’Allaire and DeRoth, 1986) experienced by the pigs during loading. This is particularly evident in pigs from compartment 4 (top deck, rear), which experienced greater increases by departure than compartment 8 (middle deck, rear). This could be due to the fact that pigs in compartment 4 are required to go up a 30° ramp to the top deck, and then they must turn around to and go up a smaller 20° ramp to enter that rear compartment. The response to multiple stressors (heat, distance moved, floor space, social mixing, handling) has been shown to be
additive (Huyn et al., 2005; Ritter et al., 2009), and so the increased GTT at loading for pigs in compartment 4 could be the result of the exercise of loading, negotiating the ramps and increased handling (Tamminga et al., 2009; Torrey et al., 2013). Although there were no significant differences in GTT at loading or departure between sprinkled and non-sprinkled pigs, it is interesting to observe that at high temperatures (> 25°C) when pigs are at a significantly greater risk of mortality during transport (Haley et al., 2008; Sutherland et al., 2009), the sprinkling treatment showed a trend towards greater reductions in GTT by arrival at the plant ($P = 0.08$). This could indicate that the sprinkled pigs are likely experiencing greater evaporative heat loss capacity when the trailer is in motion and air flow is maintained, enabling greater control of core body temperature under hotter ambient conditions when temperature control becomes more critical and physiological heat dissipation means (panting and peripheral vasodilation) become less effective (Marple et al., 1974; Robertshaw, 1985).

**Table 1. Least squares means (± SEM) of unloading time and behavior of pigs during lairage by sprinkling treatment and compartment.**

<table>
<thead>
<tr>
<th>Pig Behavior</th>
<th>Sprinkled (n=12)</th>
<th>Non-Sprinkled (n=12)</th>
<th>P-Value</th>
<th>4</th>
<th>5</th>
<th>8</th>
<th>9</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unloading Time (s/pig)</td>
<td>2.4</td>
<td>2.4</td>
<td>0.16</td>
<td>0.72</td>
<td>2.4a</td>
<td>2.8a</td>
<td>1.6b</td>
<td>2.9a</td>
</tr>
<tr>
<td>Standing (%)</td>
<td>23.1</td>
<td>24.8</td>
<td>1.50</td>
<td>0.26</td>
<td>18.7c</td>
<td>22.0b</td>
<td>29.0a</td>
<td>25.0a</td>
</tr>
<tr>
<td>Sitting (%)</td>
<td>7.9</td>
<td>10.7</td>
<td>0.50</td>
<td>&lt;0.001</td>
<td>9.7</td>
<td>8.1</td>
<td>9.8</td>
<td>9.7</td>
</tr>
<tr>
<td>Lying (%)</td>
<td>58.3</td>
<td>53.5</td>
<td>1.90</td>
<td>0.02</td>
<td>63.1a</td>
<td>61.4a</td>
<td>42.7b</td>
<td>56.3a</td>
</tr>
<tr>
<td>Latency to rest (min)</td>
<td>31.6</td>
<td>35.3</td>
<td>2.75</td>
<td>0.20</td>
<td>26.3b</td>
<td>29.3b</td>
<td>42.3a</td>
<td>36.0a</td>
</tr>
<tr>
<td>Drinking bouts</td>
<td>4.3</td>
<td>6.1</td>
<td>0.70</td>
<td>&lt;0.001</td>
<td>2.9b</td>
<td>6.0a</td>
<td>6.6a</td>
<td>5.3a</td>
</tr>
</tbody>
</table>

a,b Within a row, least squares means lacking a common superscript differ at $P < 0.05$

**CONCLUSIONS**

The results suggest that sprinkling pigs in a stationary vehicle when AmbT exceeds 23°C has the potential to prevent increases in body temperature during short duration transport without detrimental effects on ammonia levels within the trailer or on behaviour during unloading. Due to the practical limitations of installation and maintenance of sprinkler systems in trailers, further research should be done to determine the effects of water sprinkling at higher ambient temperatures. As well, examining the efficacy of sprinkling stationary trailers from the exterior, perhaps in combination with forced ventilation to improve air flow and evaporative cooling, is warranted.
Figure 3. Changes in gastrointestinal temperature (LSMEANS DGTT; °C ± SEM) from baseline (500 h the day of transport) by event and compartment group location (* P < 0.001; a,b P < 0.001).

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LITERATURE CITED


