



Short Communication

Effects of methods of confinement during transportation of market pigs on their behavior, stress and injury

Pongchan Na-Lampang*

*School of Animal Production Technology, Institute of Agricultural Technology,
Suranaree University of Technology, Mueang, Nakhon Ratchasima, 30000 Thailand.*

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Abstract

The objective of this study was to compare the effects of transport market pigs in individual crates vs. in groups on their behavior, stress and injury. The pigs were transported for 1 h on a distance of 70 km. The stocking densities were 0.35 m²/pig and 0.48 m² for groups and individual crates treatment, respectively. During loading, the group pigs had higher frequencies of climbing, slipping and turning around than the crate pigs. During transport, the group pigs engaged in fighting and agonistic interactions. There were no differences ($P>0.05$) between the two treatments in rectal temperature, respiratory rate and saliva cortisol level. Pigs kept in crates had lower ($P<0.05$) skin bruise scores but higher proportion of nonambulatory pigs than those kept in groups. In conclusion, transport in crates caused less agitation behaviors and injuries than transport in groups, but there was no differences in stress indicators.

Keywords: pig, transportation, behavior, stress, cortisol, injury

1. Introduction

It has been established that road transportation has adverse effects on the behavior and welfare as well as the carcass quality of market pigs as a result of vibration (Perremans *et al.*, 2001), regrouping of animals leading to fights (Wellock *et al.*, 2003) and other harmful effects (Ishiwata *et al.*, 2004). Transport conditions, including loading and unloading procedures, and the design of transport vehicles and equipment can have a significant effect on the welfare of pigs, and on the quality of pork (Chandler *et al.*, 1998; Ritter *et al.* 2006; Ritter *et al.*, 2008; Torrey *et al.*, 2008; Pilcher *et al.*, 2011). However, if proper handling is provided before and throughout transportation, stress levels may be reduced (Gosalvez *et al.*, 2006) even during long journeys (Brown *et al.*, 1999).

Most of the developed countries have guidelines on the pig handling and transportation. However, in Thailand no such guideline exists. Actually, no work has been conducted on the effect of transportation conditions on pig welfare and pork quality. The most popular method of commercially transport of market pigs by trucks in Thailand is by containing them singly into crates and then stacking them on the truck. The size of the crate is 1.20 m long, 0.50 m wide and 0.50 m high which is about the size of the market pig. The pig crouches in the crate all the time and its movement is restricted. The crate prevents nearly all interaction with other pigs. The pigs containing crates are stacked several layers high up to the size of the truck. This method of market pig transportation is quite unique to Thailand.

The second method and recently adopted by a few operators is by loading pigs in groups on a specially built truck. The truck bed may or may not be divided into compartments. For small pickup truck, the loading bed (2.30 m long and 1.50 m wide) is not divided. In medium or large truck (5.50 – 7.00 m long and 2.2 – 2.3 m wide), the loading bed is

* Corresponding author.

Email address: pongchan@sut.ac.th

divided into compartments. The size of each compartment is about 2 m².

It is suspected that transporting pigs in individual crates causes higher stress than transport in groups. To assess animals stress response both behavioral and physiological parameters are used. Behavioral assessments of stress response, or reduced welfare, could be vocalization, attempts to run away or just stop moving forward (Broom, 2000). Physiological measurements used are heart- and respiration rate together with body or skin temperature (Knowles and Warriss, 2000).

The present study was undertaken to compare the effects of transporting market pigs in individual crates and in groups on their behavior, stress and injury.

2. Materials and Methods

2.1 Animals and transportation

A total of 140 Duroc x (Large White x Landrace) cross-bred market gilts and barrows (equal numbers) weighing approximately 100 kg were randomly assigned into 2 treatments, designated "group" transport treatment and "crate" transport treatment. The experiment was conducted for 7 consecutive days in March 2011. The temperature during the transportation period was 32–35°C. Each day, 10 pigs were transported in groups by a standard pickup truck, and other 10 pigs were transported in 10 single pig crates by another standard pickup truck. Which truck to be used for either treatment was randomly selected every day. Both trucks were driven by the same drivers for the whole experiment to the abattoir about 70 km from the farm through the local road. The travel time was approximately 1 h. The space allowance for group transport treatment was 0.35 m²/pig which is normal for Thailand but lower than the European Committee (EC) recommendation of 0.42 m² (EC Working Group, 1992). The area of the individual crate was 0.48 m².

All loading procedures were carried out by the same personnel to standardize the handling procedures across the two treatments. Loading took place at about 1700 h with unloading of pigs at the abattoir taking place at about 1830 h on each day. The standardized handling procedure for group treatment consisted of moving groups of 10 pigs from the pen to the loading ramp and then onto the truck using sorting boards. The distance from the pen to the loading ramp was in the range of 10–50 m, depending on the location of the pen. The height of the loading ramp was 1 m. The standardized handling procedure for crate treatment consisted of moving 10 pigs, one at a time, from the pen into a crate and then lifting the crate onto the truck. The distance from the pen to the crate packing point was the same as that to the loading ramp.

2.2 Animal behavior before and during transportation

During loading onto the truck, the frequency (number of times) of climbing (escape behavior), slipping and turning

around was recorded. Animal behavior during transportation was observed through a window at a seat beside the driver and the numbers of standing (assuming or maintaining an upright position on extended legs), sitting (resting on the caudal part of the body) and lying (maintaining a recumbent position) were recorded by instantaneous sampling technique (Martin and Bateson, 2007) every 20 min beginning from five min after the start of transportation. Aggressive behaviors, fighting and agonistic acts (bites and head knocks), were recorded continuously throughout the transport. All behaviors were mutually exclusive. The percentage of each behavior during transportation was calculated by dividing the number of animals performing that particular behavior at each time point by the total number of animals (10 pigs) then multiplying by 100. The percentages of standing, sitting and lying behaviors were calculated at each 20-min interval for the entire transport period and then averaged.

2.3 Rectal temperature and respiratory rate

Rectal temperature was measured before loading, immediately after loading, and immediately after unloading, at the depth of 10 cm from the anus by a veterinary clinical thermometer. Respiratory rate was visually measured by counting the flank movements over a period of 1 min at similar times to rectal temperature.

2.4 Saliva cortisol level

Saliva samples were collected before loading, immediately after loading and after unloading with cotton swabs by allowing pigs to chew on two cotton swabs until thoroughly moistened (about 30-60 sec per sample). The cotton swabs were spun for 10 min at 932 g, before the saliva was frozen and stored at -20°C. Afterwards, cortisol in the saliva was assayed by enzyme immunoassay methods using commercial kits; Correlate-EIA cortisol (Assay Designs, Ann Arbor, MI, USA).

2.5 Identification of injury and nonambulatory pigs

Apparent skin bruises were assessed immediately after unloading using a scale from 0 (none) to 5 (severe) (MLC, 1985). Nonambulatory pigs, i.e. pigs that were not able to stand, walk or keep up with the rest of the group due to injury or fatigue (Anderson *et al.*, 2002; Ellis *et al.*, 2003), were also identified at the same time and the number was recorded.

2.6 Statistical analysis

All the data obtained were expressed as mean ± standard deviation (mean ± SD) and the differences between the two treatments were subjected to Student's paired t-test using the SAS 9.1 software (SAS Institute, Inc. 2002). P values <0.05 were considered significant.

3. Results and Discussion

3.1 Animal behavior before, during, and after transportation

During loading onto the truck, the group pigs had higher frequencies (number of animals) of climbing ($P<0.05$), slipping ($P<0.01$) and turning around ($P<0.01$) than the crate pigs (Table 1). Most of the slipping in group pigs occurred on loading and unloading ramps. There was neither climbing nor slipping among the crate pigs. This is because crate packing and unpacking of pigs were done on the floor without using ramps.

During transport, $4.38\pm 0.22\%$ of the pigs kept in groups engaged in fighting and $3.77\pm 0.30\%$ engaged in agonistic interactions. Since the pigs kept in crates were isolated from each other during transport, neither fighting nor agonistic interactions occurred.

A majority of the pigs in the group treatment stood on the truck throughout the 1 h transportation. The percentages of standing, sitting or lying animals were 64.8 ± 6.2 , 27.6 ± 4.3 and 7.6 ± 1.7 , respectively, and all were significantly different from each other. It was observed that some of the animals which initially stood on the truck sat after 15 min after the start of the trip. This finding agrees with Hunter *et al.* (1994) and Guise *et al.* (1996) who found that the greater majority of pigs stood during transport. Kim *et al.* (2004) found that almost all the market pigs stood on the truck throughout the 3 h transportation when the animals were loaded at the high- ($0.31 \text{ m}^2/100 \text{ kg BW}$) or medium stocking density ($0.35 \text{ m}^2/100 \text{ kg}$). However, there is conflicting evidence on whether pigs prefer to lie or stand during transport. Bradshaw *et al.* (1996) who studied short (40 min) transportation and Lambooi *et al.* (1985) who studied long-distance transportation (up to 1,300 km) suggested that market pigs preferred to lie down for most of the time. Since the pigs in crate treatment were forced to lie in the crates all the time, the standing and sitting postures did not exist.

3.2 Rectal temperature and respiratory rate

Rectal temperatures and respiratory rates measured before, during and after transport are shown in Table 2. The rectal temperatures as well as respiratory rates of pigs in both treatments were not significantly different at any point

of measurement. Yoshioka *et al.* (2004) reported significant increases in rectal temperature and respiratory rate immediately after loading of market weight pigs onto the truck. This indicated that loading significantly stressed the pigs. They also reported that the rectal temperature and respiratory rates tended to decrease to normal levels after the transport.

3.3 Saliva cortisol level

Saliva cortisol levels are shown in Table 2. The mean cortisol concentrations were $3.1\pm 0.74 \text{ ng/mL}$ in group pigs and $2.9\pm 0.54 \text{ ng/mL}$ in crate pigs before the loading and the loading did not increase the saliva cortisol level in either treatment ($P>0.05$). The mean values for group and crate pigs were $7.5\pm 0.42 \text{ ng/mL}$ and $7.4\pm 0.43 \text{ ng/mL}$ respectively, after the transport. Saliva cortisol significantly increased ($P<0.01$) after the transport with no treatment difference. The elevation of cortisol found in this study agrees well with Apple *et al.* (2005) who conducted a study of the effect of short-duration transportation on the stress response in pigs and found a dramatic increase ($P<0.05$) in cortisol concentration of pigs during the first 30 min of transportation, which remained elevated ($P<0.05$) above that of non-transported pigs.

3.4 Injury and nonambulatory pigs

Skin bruise score of pigs kept in groups (1.5 ± 0.07) was higher ($P<0.01$) than that of pigs kept in crates (0.5 ± 0.03). Most of the bruises found in pigs kept in groups were from fighting, whereas those in pigs kept in crates were from scratching with the crate door.

The numbers of nonambulatory pigs, i.e. pigs that were not able to stand, walk or keep up with the rest of the group due to injury or fatigue, recorded immediately after

Table 1. Behavior at loading of market pigs of different confinement methods (Mean \pm SD).

Variable	In group	In crate
Climbing (no. of times)	0.6 ± 0.3	0
Turning around (no. of times)	5.1 ± 0.7	1.1 ± 0.4
Slipping (no. of times)	1.3 ± 0.3	0

Table 2. Rectal temperatures respiratory rates and saliva cortisol levels before, during and after transport of pigs of different loading methods (mean \pm SD).

Point of Measurement	Rectal Temperature ($^{\circ}\text{C}$)		Respiration Rate (per min)		Cortisol Level (ng/ml)	
	In group	In crate	In group	In crate	In group	In crate
Before loading	38.5 ± 0.33	38.5 ± 0.25	91.3 ± 13.07	91.7 ± 11.21	3.1 ± 0.74	2.9 ± 0.54
After loading	40.8 ± 0.37	40.9 ± 0.28	145.5 ± 11.34	143.1 ± 9.23	4.5 ± 0.64	4.4 ± 0.52
After Unloading	39.6 ± 0.36	39.0 ± 0.29	123.7 ± 9.85	121.1 ± 8.45	7.5 ± 0.42	7.4 ± 0.43

unloading was significantly ($P < 0.01$) higher in crate pigs ($82.86 \pm 0.42\%$) than in group pigs ($7.14 \pm 0.18\%$). This because the crate pigs were in a crouched position all the time and when let out of the crate nearly all of them were unable to stand or walk for a few minutes. However, this was caused by fatigue rather than injury. On the other hand, all the nonambulatory incidences in group pigs were from injury of the feet or legs.

4. Conclusion

In conclusion, transportation of market pigs by road for one hour in individual crates did not cause any significant differences in stress indicators, namely rectal temperature, respiration rate, and saliva cortisol level than those compared with those transported in group. Based on the mean increase in rectal temperature and respiratory frequency, it can be concluded that both methods were very stressful in the pigs. Regarding behavior, on one hand, transporting pigs in crates severely restricted movement of the pigs and thus caused a higher incidence of nonambulatory pigs than transporting pigs in groups due to fatigue. On the other hand, keeping pigs in groups caused a higher incidence of fighting and agonistic acts and thus caused more skin bruises than keeping pigs in crates. Since both incidences have adverse effects on welfare and carcass quality of the pigs, additional research should be done on both transport methods in order to find sound solutions and set up guidelines on commercial pig transport in Thailand.

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