EFFECT OF DIFFERENT STOCKING DENSITIES DURING TRANSPORT ON PIG WELFARE

Patricia Barton Gade
Danish Meat Research Institute, Maglegaardsvej 2, DK-4000 Roskilde, Denmark

Background.

Optimal stocking density for pigs during transport has been a subject for debate in recent years. EU Directive 95/29/EF states that all pigs should as a minimum be able to stand and lie down naturally and recommended that a stocking density of 0.42 m^2 per 100 kg pig. The value of 0.42 m^2 per 100 kg pig was suggested by *Lambooij et al. (1985)*, as a suitable compromise between welfare, meat quality and transport economy for long distance (2 day) transports. However, the majority of transports of pigs for slaughter have been found to be less than 2 hours in a survey of 7 European countries *(Christensen et al., 1993)* and the above figure may not be appropriate for shorter transports. There are 2 schools of thought: "More space during transport allows pigs to lie down and rest more quickly with better welfare as a result" and " Pigs do not in general lie down during short transports and a fairly high stocking density that allows pigs to support one another during transport will reduce the risk of injury".

Objective.

To evaluate the effect of four different stocking densities during transport on pig welfare for shorter (3-3½ hours) transports.

Methods.

The experimental material consisted of 360 pigs from one producer who could deliver 45 pigs on 4 consecutive days and 2 consecutive weeks. Pigs were mainly 4-breed crosses of Landrace, Large White, Duroc and Hampshire with average slaughter weight of 84.6 kg. Transport took place in a single decked vehicle with air suspension on all axles, a tail-gate lift, non-slip rubber flooring, good (natural) ventilation and 4, equally large, compartments. Due to the tail-gate lift the actual floor space available was, however, slightly smaller in the rear compartment. Four different stocking densities were aimed for: 0.35, 0.39, 0.42 and 0.50 m^2 per 100 kg pig. These corresponded to the value used for internal Danish transports of less than 4 hours duration (0.35), an intermediate value (0.39), the EU recommendation (0.42) and finally, the EU recommendation + 20 % (0.50). All 4 stocking densities were used on each transport and the compartments were changed from day to day, so that for each week all stocking densities were represented in each of the 4 compartments. The transport vehicle was equipped with 4 video cameras placed over the centre of each compartment, so that all animals were visible. Pigs were marked individually with a number sprayed on their back at loading, so that each could be identified during transport. The video cameras were turned on as loading commenced and turned off at unloading. The average transport time was 3 hrs and 9 mins with a variation from 3 hrs to 3 hrs and 25 mins. Temperatures at the start of the transport varied from 14 to 20 °C with 18 to 26 °C at the end of the transport. Weather varied mainly between sunny to overcast. During the transport there were 2 short 5 min stops (after 51mins and 2 hrs 17 mins respectively) and one of 15 mins duration (after 1½ hrs transport). In addition, details of road conditions were noted for the whole transport, *e.g.*, start/stop, sudden braking, roundabouts and 90 ° turns. On arrival at the abattoir compartments were off-loaded and kept separately in the lairage. To get a true picture of the effect of transport, pigs were sent for immediate slaughter without resting using the low stress group stunning system with no goad use *(Barton Gade et al., 1995)*. Blood samples were taken at exsanguinations for the analysis of cortisol (Endab immunoassay, Immunotech Corp., Boston, USA). 25 mins *post mortem* pig carcasses were subjectively evaluated for rigor development in the shoulder (1=relaxed, 3= full rigor) and skin damage assessed using a standard set of photos (scale 1-4), as described by *Barton Gade et al., 1996)*. The cortisol results were investigated using an analysis of variance with stocking density as variable (SAS 1988) and rigor development/skin damage using a χ^2-test. The video recordings were evaluated for the 2 stocking densities closest to 0.35 and 0.42 m^2 in any one transport and such that compartment distribution was as even as possible. For each, pig behaviour was evaluated every 2½ minutes: Body position: standing, sitting, lying, Orientation relative to driving direction: facing towards/away from the driving direction, across the driving direction, diagonal to it, Factors that can cause damage: trodden on by other pigs, aggression (fast sideways movement of the head, bites or receives a bite) and Balance: balanced, slightly swaying, swaying/difficulty in keeping balance, falls. The behaviour of each pig was evaluated using changes in body position during stops and as transport progressed and the occurrence of events likely to cause damage. The results were evaluated using a χ^2 test.

Results and discussion.

Actual stocking densities varied from those aimed at, due to variations in live weight of the group concerned, so that the 4 densities actually used were: 0.34, 0.37, 0.41 and 0.49 m^2 per 100 kg pig. Cortisol levels were respectively 8.57, 8.40, 7.17 and 7.56 µg per 100 ml, which was not significant at the 5 % level (p = 0.104). Most of the carcasses were relaxed in the shoulder at 25 mins *post* mortem and very few shoulders were in rigor at this time, irrespective of stocking density (p=0.558). The results of the skin damage scores are shown in Table 1. There were significant differences between stocking densities for skin damage in the middle and the shoulder area (p= 0.003 and 0.026 respectively). Scores 3 and 4 are indicative of unacceptable skin damage and 0.49 m^2 gave slightly lower percentages with score 3 and 4 in the middle compared to the other stocking densities, whereas 0.34 and 0.49 m^2 had slightly higher percentages with scores 3 and 4 in the shoulder than the other two stocking densities. Thus, there was no systematic change in the percentage of carcasses with unacceptable skin damage with stocking density, which did not confirm previous results *(Barton Gade and Christensen, 1998*), that showed that a stocking density of 0.42 m^2 gave higher percentages of unacceptable skin damage in all parts of the carcass compared to stocking densities of 0,35, 0.39 and 0.50 m^2. The behavioural studies showed that orientation of the pig relative to driving direction was random for both stocking densities. Regarding body position, it had been the intention to note the time that the individual animals began to sit and to lie. However, this rarely happened. Pigs did begin to sit and lie as transport progressed but were often disturbed by the driving pattern or by other pigs wanting to change position. Braking and acceleration combined with turns or roundabouts disturbed pigs irrespective of stocking density. It was decided therefore to count how many times the animal was standing, sitting or lying and use the percentage as a measure of body position. The results are shown in Table 2. Considering the transport itself, there is a general trend towards fewer pigs standing and more pigs sitting and lying as transport progressed for both stocking densities. There were always more pigs standing and fewer pigs sitting with 0.42 m^2 than with 0.36. After 1½ hours transport there were more pigs lying with 0.42 m^2 than with 0.36. However, the percentage of pigs lying was relatively small for both stocking densities. During stops, where there was a greater possibility of pigs resting, there were fewer standing and more sitting and lying than during transport, especially for the 15 min stop. There was no difference between stocking densities for the first short stop but there were fewer pigs standing and more pigs sitting with 0.36 m^2 during the second short stop. With the longer stop of 15 mins there were fewer standing and lying but more sitting pigs with 0.36 than with 0.42 m^2. The results of this experiment show that there is no increased tendency for pigs with more space to lie during transport and confirms therefore the results of *Barton Gade and Christensen, 1998, Hunter et al., 1994 and Bradshaw et al., 1996.* Regarding factors that can increase the risk of damage slightly more pigs lost their balance during sudden breaking with 0.42 m^2 than with 0.36 (15.7 as against 10.9 %) but the difference was not statistically significant (p=0.361). The pattern of losing balance was, however, different for the 2 stocking densities, being more of a stumble, where the animal was quickly on its feet again with 0.36 m^2 and more of a fall proper for 0.42 m^2. The risk of damage (which did not occur in this experiment) is clearly higher with the lowest stocking density. Other factors that can cause damage such as pigs treading on one another and aggression occurred at an extremely low incidence in this work and were not different for the 2 stocking densities.

Conclusions.

There was little effect of stocking density on measures of stress such as blood cortisol or early rigor development. Significant differences seen in incidence of unacceptable skin damage were not systematic. The EU recommendation of 0.42 m^2 did not lead to more pigs resting during transport compared to 0.36 m^2 and the indications towards a greater risk of damage with 0.42 compared to 0.36 m^2 were slight in this work. The hypothesis that more space during transport allows pigs to rest more quickly with better welfare is not borne out by the results of this work and a value of 0.42 m^2 does not seem to be necessary for shorter transports.

Literature

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Table 1: % distribution in skin damage scores in relation to stocking density during transport

Skin damage score		Stocking density 0.34 m^2	0.37 m^2	0.41 m^2	0.50 m^2	p-value
Leg	1	61.2	74.0	73.9	70.8	0.330
	2	36.9	25.0	23.9	29.2	
	3	1.9	1.0	2.3	0	
	4	0	0	0	0	
Middle	1	13.7	38.5	27.3	36.1	0.003
	2	76.5	55.2	64.8	61.1	
	3	9.8	6.3	8.0	2.8	
	4	0	0	0	0	
Should.	1	16.5	35.4	27.8	36.1	0.026
	2	63.1	53.1	61.4	45.8	
	3	20.4	11.5	10.2	18.1	
	4	0	0	1.1	0	

Table 2: Body position in relation to stocking density during transport

Transport 1: start to 51 mins;
Transport 2: from 56-90 mins;
Transport 3: from 1 hour 45 mins to 2 hours 17 mins
Transport 4: from 2 hours 22 mins to 3 hours 9 mins

Description	0.36 m^2 stand %	sit %	lie %	0.42 m^2 stand %	sit %	lie %	p-value
Transport 1	**87.4**	**10-3**	**2.3**	**93.9**	**5.2**	**0.9**	**0.001**
Stop 5 min.	73.6	21.1	5.3	73.4	19.8	6.4	0.866
Transport 2	**74.5**	**23.0**	**2.5**	**81.2**	**16.0**	**2.8**	**0.001**
Stop 15 min.	39.8	37.8	22.4	45.7	20.9	33.4	0.001
Transport 3	**48.7**	**46.6**	**4.7**	**66.1**	**25.0**	**8.9**	**0.001**
Stop 5 min.	39.8	39.8	20.4	52.3	24.4	23.3	0.006
Transport 4	**59.7**	**35.2**	**5.1**	**64.4**	**23.5**	**12.1**	**0.001**
Transp.total	68.5	27.9	3.6	77.0	16.9	6.1	0.001