PE1.59 Investigation of pig transports for more than 8 hours in cold and warm weather conditions and of the requirements for ventilation during the transport 371.00

Leif Christensen (1) lch@danishmeat.dk, Lars Blaabjerg(2), Jörg Hartung (3)
(1)Danish Meat Research Institute
(2)Danish Meat Research Institute
(3)Institut für Tierhygeine, Tierschutz und Nutztierethologie der TiHo Hannover

Investigation of pig transports for more than 8 hours in cold and warm weather conditions and of the requirements for ventilation during the transport

Leif Christensen, Lars Blaabjerg - Danish Meat Research Institute, Denmark Prof. Jörg. Hartung - Institut für Tierhygeine, Tierschutz und Nutztierethologie der TiHo Hannover, Germany.

I. INTRODUCTION

For many years, Danish legislation has demanded mechanical ventilation in multi-tiered vehicles for transport of pigs. This demand is now a part of EU legislation for transport for more than 8 hours and implemented via EU Regulation (E) No. 1/2005 dated 22 December 2004. Previously, the subject was dealt with in an EU working group: Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to Standards for the microclimate inside animal road transport vehicles (EFSA 2004). We may thus assume that in time the EU will incorporate further demands on ventilation into the legislation. As it appears from the report from the EU Committee, only limited documentation exists in relation to the effect of ventilation conditions during transports of pigs for more than 8 hours or transports of piglets, slaughter pigs and sows carried out during warm and cold periods. This situation is not satisfactory to haulers just as it is a precarious matter as the aim for better animal welfare can easily be overshadowed by undocumented demands that will not ensure the best possible welfare for the animals. The lacking documentation can result in vehicle constructors not always being in the clear with respect to conditions relating to design of lorry bodies and the level of investment required. The above formed the basis for initiating the investigation reported in this document. The purpose of the investigation was to document the actual ventilation conditions in a multi-tiered transport vehicle and to substantiate:

The need for natural and mechanical ventilation

Good animal welfare based on results from investigations

Whether a need exists for heating of lorry bodies used for transport of pigs of approx. 25 kg, and if so what does this involve

Future design and use of ventilation equipment and sprinkling system, if required The results can also be used in discussions with the authorities and animal welfare organizations and thus contribute to a new code of practice based on documented facts.

II. MATERIALS AND METHODS

A. Transport vehicle

The transport vehicle used for the investigation was designed in accordance with instructions given in the Manual for Pig Transports (named: HST), written and edited by Danish Meat Research Institute, with one exception only: finding a hauler conducting long-distance transports with a lorry containing rubber flooring was not possible. In stead of using rubber surface as flooring in the transport vehicle, a non-skid aluminum surface was used. The transport vehicle used for all experiments/transports comprises a fore carriage and a hanger. The chassis of the fore carriage was of the make Volvo FM12 with a long driver's cab and complete air suspension. The chassis of the hanger was constructed by the company Menke, 49575 Werite, Germany and was also equipped with complete air suspension. The lorry body of the fore carriage as well as of the hanger was also built by the company Menke, 49575 Werite, Germany. The walls had two-ply aluminum profiles that provide insulation from the stagnant air between the plates. The roof had two layers of glass fibres with a 50 mm insulation material between the layers, and the individual tier had non-skid ribbed aluminum flooring. The tiers on the fore carriage and the hanger were mobile and adjustable for transports in 1, 2 or 3 tiers. All compartments in the fore carriage and hanger, respectively are 5.33 m2 and 5.79 m2.

On each tier, two compartment gates were mounted dividing the tier into 3 compartments. The compartment gates were of aluminum with a plate covering the lower 600 mm of the gate and with bars above the plate. The compartment gates had a total height of 800 mm and ensured ventilation between and through the individual compartments. Openings for natural ventilation were evenly distributed along the sides of the carriage. The openings had a max. nominal height of 350 mm (actual height was 310 mm) and a length of 820 mm, except the first row on the fore carriage which was 700 mm long. The openings could be adjusted independently. Furthermore, the carriages were equipped with mechanical ventilation. 3 fans were mounted on the lower tier, 3 on the middle tier and 3 on the upper tier for each individual compartment. On the sides of the lorry body ventilation openings were placed for each compartment. The ventilation openings were manually operable. Depending on the outdoor temperature and natural ventilation, mechanical ventilation could be activated in all compartments. The mechanical ventilators were placed at the same level above the floor as the openings for natural ventilation. For use during warm periods, a sprinkler system was mounted in the lorry body. The mechanical ventilation as well as the sprinkler system was not operated by the actual temperature in the truck body. Sensors mounted on the front-board of the lower, front compartment on the fore carriage provided information to the driver of actual temperatures via a display in the driver's cab, and the driver had to start-up the mechanical ventilation and sprinkler system when he received the information on the display. The transport company had no written guidelines as to when mechanical ventilation and sprinkler system were to be started. The HST manual from DMRI describes the constructions only and not how to use them. The drivers informed us that usually they would activate the ventilation and sprinkler system as follows:

The ventilators: when the temperature in the compartment reached approx. 20oC

Sprinkler system: when temperatures exceed 24oC Temperatures were chosen on background of the Livestock Weather Safety Index (LWSI). Ventilation openings were adjusted in accordance with the time of year and type of pigs transported. During the summer, the openings in both sides of the truck are identical whereas in the winter the ventilation openings vary from left to right side of the truck body.

B. Collection of pigs and duration of transports

All pigs were collected directly at farms and transported to the hauler in Randers for further transportation to German slaughterhouses or farms when piglets were transported. The average transport time was approx. 9 hours. Shortest and longest time of transportation was 7:21 and 12:25 hours, respectively

C. Number of transports and transported pigs

12 transports containing a total of 2,643 pigs were carried out as follows:

333 sows - 4 transports, 2 during the summer and 2 during the winter

329 slaughter pigs - 4 transports, 2 during the summer and 2* during the winter

1981 piglets - 4 transports, 2 during the summer and 2 during the winter

Registrations upon arrival were only carried out for one of the winter transports, as it was not possible to reach the destination in time.

D. Measuring and surveillance equipment

Measuring equipment for registration of temperature and humidity was installed in all compartments in the lorry body . Outdoor temperature and humidity was registered as well. For measuring temperature and humidity, Gemini Data Loggers, Tinytag plus TGP-4017 and Tinytag Ultra TGU-1500 were used. CO2-content was measured in the front and rear compartments on the lower and upper tiers of the fore carriage and hanger using IR technology. Type VE from Company N. Veng, DK was used. Heart rate was measured for randomly selected slaughter pigs and sows only, as it was not possible to find equipment for piglets that could be used without comprising risk for their welfare. Polar Electro, model 810i mounted in HR belts made at DMRI were used. To monitor behavior during transport surveillance cameras were installed in the front and rear compartments on the lower and upper tiers of the fore carriage and hanger. IR cameras, level range from 0 lux, type KD-320S121\N were used.

III. RESULTS AND DISCUSSION

E. Temperature, relative humidity and CO2 measurements.

Looking at correlations between temperature and humidity measurements in different compartments in the lorry provides us with a clear pattern of where to place measuring equipment for registration of temperature to observe registrations required by EU legislation. Using the front compartments in lower tiers and the rear compartments in upper tiers for registration of temperatures will give a satisfying indication of temperature levels in the rest of the compartments in the lorry. For certain levels of relative humidity in connection with certain temperature levels, awareness must be shown when the vehicle is standing still for a longer period of time, say approx. 30 minutes. According to observations and measurements it seems that the limits 5 - 30oC ±5oC, as stated in the EU legislation, are satisfying, and pigs should not suffer any harm if the vehicle has a mechanical ventilation system and the drivers is using the system correctly. Heating of the lorry body does not appear to be necessary when looking at figures. Negative combinations of temperature and relative humidity can occur (LWSI). Especially when temperatures are above, or in time before it reaches 24oC, mechanical ventilation can to some extend avert the situation. No CO2 measurements have exceeded 3360 ppm during the investigation. It can be discussed why there should be a difference in levels between humans and animals. Neither of these levels have been exceeded during the investigations and there seems to be no need for making CO2 measurements compulsory on vehicles transporting livestock. In case of ventilation failure in a lorry, animals could die from heat stress more likely than from elevated CO2 levels. CO2 concentrations above 10.000 ppm can trigger the respiration centre in the brain of pigs and increase respiration frequency. Usually, there are sufficient gaps and openings in the side walls of the lorry body to let the CO2 escape easily, but on some occasions not air flow enough to prevent increased temperature and causing the relative humidity to rise. Failure of ventilation will be signaled by increasing temperature and relative humidity, more promptly than by CO2 measurements. This was observed once during this investigation where the combinations of temperature and relative humidity exceeded critical levels on a fully laden static lorry without any activation of mechanical ventilation. Looking at temperature, humidity and CO2 levels during transports and the state of pigs during offloading it seems that ventilation openings in the lorry bodies used in this investigation have been sufficient to ensure good micro-climatic conditions in the lorry body. But it is still important to be able to control the environment in the vehicle by means of mechanical ventilation and sprinkling of the pigs in warm weather. During transport, the pigs irrespective of size have preferred to lie down in groups making a free space in the compartments of 20-30 % of the actual floor space. There was a normal level of activity and as was seen in previous transport investigations a very low frequency of aggression and fights as long as the lorry is moving. The low frequency of fighting seen in the recordings does not correspond to the amount of skin-damage seen when offloading. This indicates that transport is not the only factor that can be related to occurrence of skin-damages. Fighting before on-loading where pigs are kept in larger groups is most likely to be the trigger.

F. Heart rate monitoring

Monitoring heart rate on slaughter pigs and sows caused some problems due to practical conditions of the long-distance transports. However, it was still possible to obtain some sequences that stretched out over full or partly full duration of the transports. The heart rate of slaughter pigs was at the same level as in housing conditions or slightly higher and did not differ from experiences of similar investigations and with similar lorry constructions in use. The average heart rate was 112 in the summer and 103 in the winter, with a minimum registration of 83 and 67 heart beats per minute. In general, sows showed a slightly higher heart rate level than slaughter pigs, thus the basic level for sows in housing conditions is not measured and it is not known if the heart rate level for sows in general is higher than for pigs for slaughter. The average heart rate was 124 in the summer and 121 in the winter with a min registration of 79 and 70 heart beats per minute. These figures do not differ from earlier transport investigations. No measurements were carried out on piglets as it was not possible to find equipment to be used without comprising the welfare risk.

G. Veterinary conditions

Prior to transport, all pigs have been checked by a veterinarian from the Danish Regional Veterinary and Food Control Authority. All pigs were considered fit for transport. Veterinarians from Institut für Tierhygeine, Tierschutz und Nutztierethologie der TiHo Hannover, Germany inspected the animals upon arrival at destination points; measured body core temperature and collected data from heart rate monitors and data loggers measuring temperature and humidity. None of the slaughter pigs or piglets died during transport or shortly after arrival at the destination. 6 sows died during transport or immediately after off-loading. One died of unaccountable reasons, one collapsed at arrival because of heart failure and four

were found dead in one of the rear compartments of the lorry at arrival. The death of these four sows corresponds to the amount of deaths during transports with long time stops or very slow driving in combination with rather high temperatures and relative humidity and no mechanical ventilation. The reason for not using mechanical ventilation on these specific transports was lack of information on how and when to handle the mechanical ventilation system. This has changed as the drivers' manual has been updated. Injuries were seen, but they did not correspond to the level of fighting etc. observed via cameras in the compartments. A more thorough inspection and registration of skin damage due to fighting and other damages during on- loading could have provided better information of when and where. High temperatures without sufficient mechanical ventilation have had a negative influence on some of the sows transported. Transporting pigs in temperatures below 5oC did not influence the pigs in a negative way.

IV. CONCLUSION •

Lorries should be provided with mechanic ventilation system (MVS) • MVS should be started up when the temperature exceeds above 20-21oC to keep compartment temperatures below 24oC. • Ventilation openings of 100 mm on one side of the lorry and closed on the other side seems to suit transports during winter (outdoor temperatures below 10 - 15oC) • Ventilation openings of nominal 300 mm (must also be ≥20% of floor area) can be calculated as "free space" with reduction of bars etc. down to 250 mm. • Sprinkler systems can be used when temperatures are above 24oC, but only for short periods of a few seconds, yet the system can be used several times during an hour (the optimum interval is not known) • If the limits 5 - 30oC ±5oC, as stated in the EU legislation, are observed pigs should not suffer any harm if the vehicle has a mechanical ventilation system and the drivers have been instructed in how to use the system correctly. •

The drivers must be able to control the temperature in the warmest/coldest compartments from the driver's cabin • The drivers must know these guidelines which are to be kept in the driver's cabin and be in a language that the driver can read and understand • Registrations carried out upon arrival shows that the amounts of damage during long-distance transports are not exceeding the amount of damage during shorter transports. •

Instructions given in the Manual for Pig Transports (named: HST) for lorry-design reveal that we are close to having a well functioning design. Still, final adjustments are still needed as well as looking at automatic or semiautomatic control systems for ventilation and water nozzles on lorrys.

ACKNOWLEDGEMENT

F.A. Authors thank Maiken Baltzer, Jesper Blom-Hanssen, Peter Vorup from the Danish Meat Research Institute, Denmark and Harald Ulbricht, Claudia Dold, Tierhygeine, Tierschutz und Nutztierethologie der TiHo Hannover, Germany, for their contribution to this project.

REFERENCES

(1) Kraft, J., (2005): Klimat i djurtransportbil med slaktgrisar sommertid – Jämförelse mellan naturlig och mekanisk ventilation. Sveriges Lantbruksuniversitet, Institutionen för biosystem och teknologi. Examensarbete 18, Alnarp 2005.

(2) Christensen, L., and Barton Gade, P., (1997). Heart rate and environmental measurements during transport and experience from the routine transports with the experimental lorry. Report No. 02.674 - Danish Meat Research Institute AIR Project, AIR-3-CT 92-0262.

(3) Christensen L., and Barton Gade, P., (1995). Design of Experimental Lorry for Transport of Pigs and some preliminary results of environmental measurements. Report No. 02.674 - Danish Meat Research Institute AIR Project, AIR-3-CT 92-0262.

(4) Randall, J.M., Stiles, M.A., Geers, R., Schütte, A., transporters: implications for reducing stress. Proceedings of the EU-seminar "Methods of improving pig welfare by reducing stress and discomfort before slaughter" 29-30 June 1995, Mariensee, Germany: 143-160.

(5) Christensen, L. and Jonsson, K. (2007) Optimization of transport conditions in relation to transport mortality. Report No. 02.763 reg.nr. 403290.1 - Danish Meat Research Institute