ORAL PRESENTATIONS

MEASUREMENT OF THERMAL STRESS IN SLAUGHTER CATTLE DURING LONG ROAD TRANSPORT

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SUMMARY

Heat stress is seen as one of the major aversive factors during long distance road transport of cattle entailing poor welfare. The thermal environment of 587 slaughter bulls was continually monitored inside the lorry during 15 trips for 24 h (mean) between July and October from Germany to Italy and blood samples were analyzed for stress indicators. The stress factors analyzed in the blood remained within limits that did not show any detriment or damage to the animals. None of the animals became clinically ill. The risk of heat stress in slaughter cattle on long transports seems to be overemphasized if vehicles and organization are appropriate.

Keywords: cattle, long transport, heat stress, THI, blood constituents

INTRODUCTION

In 2002 about 80 million cattle were kept in the European Union. Most of these animals are transported less than 8 hours and 45 million cattle are transported not longer than 4 hours with about 16 million going to nearby farms and about 29 million to slaughter houses. The number of cattle being transported longer than 8 hours is less than 2% only but attracts most public attention. These animals are usually imported from or exported to third countries (for 2002: about 530,000 cattle imported and about 300,000 exported) (Schons 2003). One main concern associated with such long transports is heat stress the animals may suffer during the transport journey.

This paper reports about temperature and humidity measurements on lorries during long transports of slaughter bulls from the north of Germany to the Mediterranean port of Trient in Italy in order to address the thermal stress experienced by the animals (Brüser-Pieper 2006). The journey times were for up to 27 hours. Blood samples were taken from a number of indicator animals on each transport to analyze certain blood constituents which may be associated with stress reactions.

MATERIALS AND METHODS

The thermal environment of 587 slaughter bulls was continually monitored during fifteen trips between July and October 2002, and described according to the itinerary traveled. Temperature, relative air humidity and air movement were thereby measured in 4 of the 5 bays of the transport vehicles. Direct comparisons to the outside climate were made. On each transport, blood samples were taken from 190 indicator animals 12 hours before loading, directly before loading, at the end of the transport, directly after unloading and 24 hours after the end of the rest period in the port of Trieste. The following parameters were determined from these blood samples and compared to clinical reference ranges: cortisol, creatinine kinase, glucose, non-esterised fatty acids, β-hydroxybutyrase, total protein, sodium, potassium, hematocrit, magnesium, triiodthyronine (T3), and thyroxine (T4). The results were interpreted in light of the environmental conditions of the animals, so that it was possible to draw a conclusion on the effect of the observed thermal stress to the animals' health and well-being on transports of up to 27 hours.

RESULTS

Figure 1 shows the course of the mean temperatures measured over about 24 h inside the vehicles during 15 transports of slaughter bulls from the north of Germany to Triest in Italy between July and October 2002.

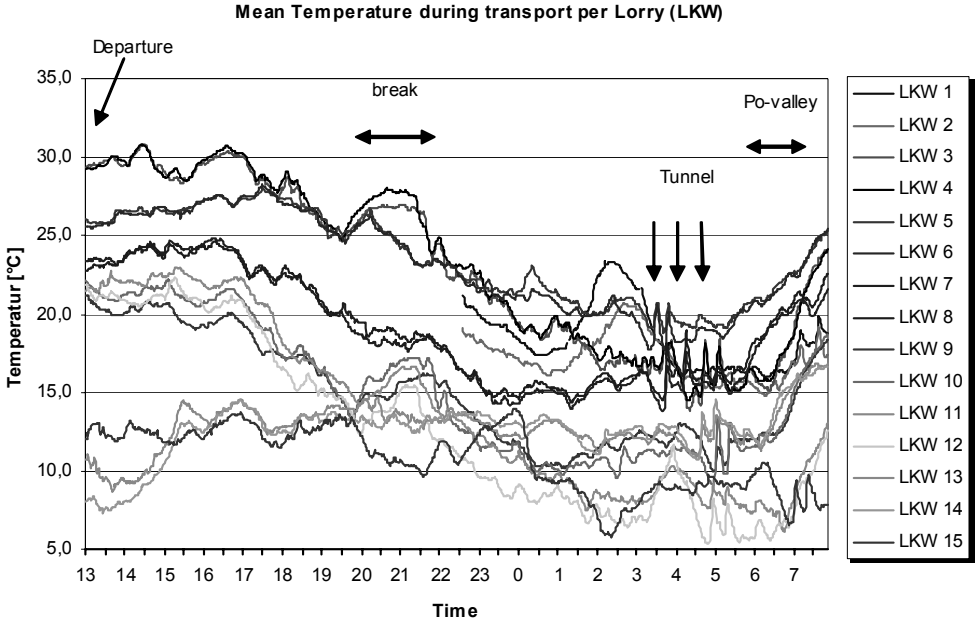

Figure 1. Mean temperatures during 15 transports of slaughter bulls from the north of Germany to Triest in Italy during 24 h

The temperature inside the lorry depends very much on the outside temperature and the waiting time when the lorry is loaded. During the hot season 30 °C are reached before departure. During the journey the inside temperature decreases with the increasing natural ventilation. Temperatures are falling in the evening and during the night. Breaks and tunnel passages increase temperatures again because of lacking ventilation or increased temperatures inside the tunnel. In the morning the temperatures are increasing with the rising sun in the river Po valley. It is important that the animals are unloaded immediately after arrival at destination in the harbour.

Table 1 gives the corresponding relative humidity of the air inside the lorry as means with minimum and maximum values. When the temperatures are high during driving the relative humidity is low and vice versa, when the lorries are standing fully loaded both temperature and humidity is increasing.

Table 1. Relative humidity of the air inside transport vehicles with slaughter bulls during 13 journeys from the north of Germany to Triest in Italy

LKW/lorry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Minimum	–	–	45,2	46,4	57,3	56,3	41,5	41,0	63,6	54,4	51,6	48,0	57,7	57,9	35,2
Maximum	–	–	88,8	86,7	94,5	92,3	86,8	87,0	86,9	90,2	93,8	92,8	97,7	95,9	84,6
Mean	–	–	**68,7**	**69,5**	**74,4**	**73,1**	**61,9**	**60,9**	**73,9**	**71,9**	**70,6**	**70,9**	**81,2**	**79,3**	**69,4**

Both temperature and humidity can act together as stressors for animal and man. Thom (1959) introduced a thermo-humidity-index (THI) to characterize the combined effect of the environmental climatic conditions (dry temperature, relative humidity, dew point). This concept was adapted for cattle in the Livestock Weather Safety Index (LCI 1970). Table 2 gives the categories from normal (<74) to acute danger of life (>84).

Table 2. Thresholds of the Livestock Weather Safety Index (LWSI) and the basic THI values

THI	< 74 normal
	75–78 threshold of thermoregulation
	79–83 danger
	> 84 acute danger of life

Figure 2 shows the distribution in % of all THI classes in lorries 3–15 between departure and arrival. THI values higher than 78 were observed during two journeys in summer for about 24% and 10% of the journey time. These time spans were, however, composed of different periods at the beginning of the journey after loading, shortly during breaks at day time and again before unloading at destination. It is presently not known what the adaptation capacity of slaughter bulls for increasing heat burdens during transport is. It may be assumed that short periods of increased temperatures are tolerated by the animals. Here more research is needed.

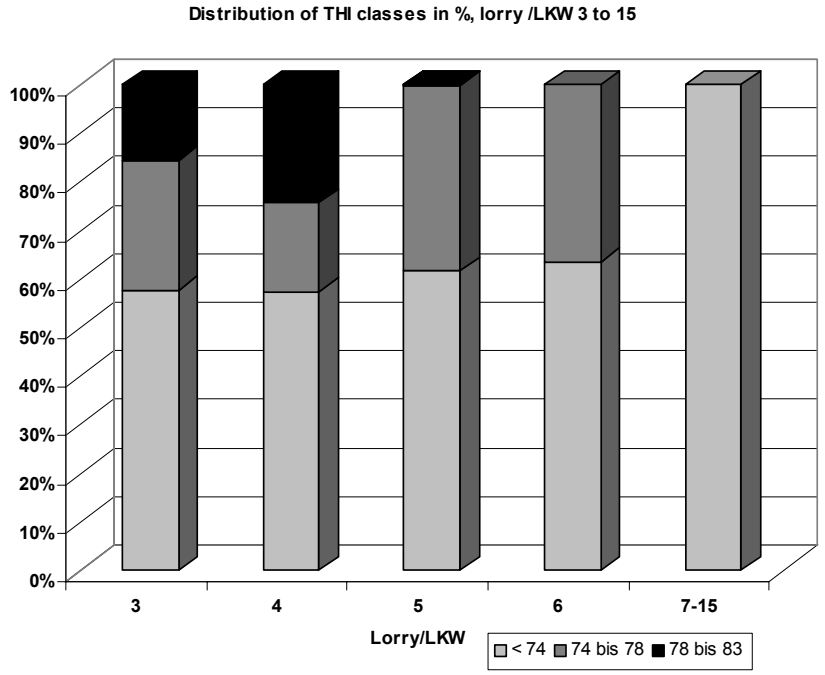

Figure 2. Distribution in % of all THI classes in lorries 3–15 between departure and arrival. Classification according to Livestock Weather Safety Index (LCI 1970)

DISCUSSION

It became clear that the thermal stress experienced by the slaughter bulls was primarily dependent on the season. During four transports in August, average values of 70 THI-units were found in proximity of the animals, whereby maximum values of 78 and 82 units were measured for short periods of time until arrival at the port. The later transports were found to average fewer than 65 THI-units. Air movement through ventilation in the moving vehicle was found to be sufficient to keep the temperature and relative humidity within endurable limits. When the vehicle was not moving however, the air movement fell to low values and resulted in a continuous increase of temperature and relative humidity for the duration of the stop. These increases were more significant if the vehicle stood in direct sunlight and with decreasing winds.

The analysis of the blood samples showed that not all parameters were influenced by the transport. However, clear differences from reference ranges were found before loading in the values for cortisol, glucose, hematocrit and triiodthyronine and mirrored the general stress reactions of the animals to the unknown situation. After arrival at the port and an average of 23.5 hours of transport, the values that had been elevated before transport remained relatively elevated. It was still possible, however, to conclude that the animals got habituated to the transport situation as they progressed. In addition to the previous parameters, the volatile fatty acids were found to be increased after unloading. This was attributed to reduced feed consumption during transport. On arrival, the values for creatinine kinase were found to be increased and continued to increase

strongly during the 24 hour stop at the port. This is attributed to the new grouping of the bulls after transport, which led to constant rank fighting and drastically increased physical activity. There were indications that, particularly in the summer transports, certain animals did not sufficiently access the continuously available water sources.

In general, the magnitude of the increase of the stress factors in the blood samples beyond the reference ranges remained within limits that did not show any detriment or damage to the animals. None of the animals during the 15 transports became clinically ill. There was no indication that the animals' thermoregulatory capacities could have been overwhelmed. It seems that slaughter bull transports of 22 to 27 hours can be accomplished without putting exaggerated strain on the animals. However, the results demonstrate that the animals can be submitted to significant thermal stresses during transports in the summer, especially during stops. Through careful planning and mindful executing of transports, with adequately trained personnel, it is possible to minimize the stress on the animals before critical temperatures are reached. The future records of the position of the vehicles (e.g. by global positioning systems, GPS) may also help to avoid heat stress by early advisory models.

ACKNOWLEDGEMENT

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