The impact of the transport distance and season on losses of fattened pigs during transport to the slaughterhouse in the Czech Republic in the period from 1997 to 2004

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ABSTRACT: The welfare conditions in animal transport have a significant impact on the levels of stress burden on animals before slaughter in the slaughterhouse, and have an impact on veterinary decision-making about meat and organ edibility, and also on the quality of slaughtered animal meat. The ratio of ensuring the level of welfare in animal transport can be taken as the numbers of animals having died during transport and having died in the slaughterhouse shortly after transport is completed. As to the kinds of animals raised for meat, the issue of mortality in relation to transport is especially significant in pigs. In the period from 1997 to 2004, the transport of slaughter pigs, in terms of the protection of the animals against cruelty, was monitored in the Czech Republic. The aim was to ascertain pig losses in relation to transport to the slaughterhouse, to find out the impact of transport distance on losses of these pigs, and to determine the impact of the different seasons on losses of these pigs. The data concerning pigs fed for slaughter in the slaughterhouse (fattening pigs) was analysed, the data did not include the information concerning small sows, sows and boar kept for breeding and now excluded from breeding and slaughtered in the slaughterhouse. We have established the pig mortality level to be 0.107% ± 0.013%. However, this mortality level changed depending on the transport distance – from 0.062% ± 0.007% in the case of transport distances up to 50 km, to 0.335% ± 0.113% in the case of transport distances over and above 300 km. The level of losses of pigs increased with the length of transport distances, which is given to the long-term and higher-stress burdens in these pigs caused by longer transportation times. The seasons are expressed by the individual months, and had an impact on the transported pigs' mortality number. Altogether, the highest losses occurred in the summer months, especially in June, July, and August. The increased mortality in the summer months is related to the higher ambient temperature in these months, which has a negative impact on the welfare of the pigs, and thus also on the higher pig losses during transport. The ascertained results produced evidence for the relatively high sensitivity of pigs to the stress burden caused by transport to the slaughterhouse and showing themselves in the number of pigs having died due to transport. The increasing transport distance and higher ambient temperature in the summer months show themselves in the increased number of pigs having died in relation to their transport to the slaughterhouse.

Keywords: welfare; stress; slaughter pigs; transportation time; ambient temperature; summer months

Ensuring the welfare conditions of animals during transport to the slaughterhouse is one of the most important factors positively influencing the level of stress burden of transported animals. Not keeping the welfare conditions during transport of animals has a significant impact on the increase of stress burden in animals before slaughter in the slaughterhouse, and has an impact on veterinary

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decision-making about meat and organ edibility, and also on the quality of slaughtered pig meat.

Transport to the slaughterhouse is a considerable stress burden for pigs. The stress burden level of pigs is especially influenced by the method of treatment of animals at the point of loading, during transport, at the unloading of animals from the transport means and before slaughter, and further by the grouping of animals for transport, loading density, transport distance and transportation time, the method of transport, feeding and medication of feed-stuffs before transport of the animals.

Loading and unloading influence the stress burden in transported pigs (Perremans and Geers, 1996). Geverink et al. (1998) investigated the effect of regular moving and handling on the behavioural and physiological response of the pigs to pre-slaughter treatment. They determined that the pigs that had experience leaving their home pen and some of the transport conditions were much easier to handle at loading. Kuchenmeister et al. (2005) compared the stress burden of pigs: immobilisation by a nose snare with the use of an electrical goad. The stress effect was the highest in goad pigs.

The impact of mixing with unfamiliar co-specifics on the stress burden of pigs in relation to their transport to the slaughterhouse is emphasised by Perremans and Geers (1996).

Warriss (1998a,b) dealt with stocking densities for slaughter pigs transported by road. He says that higher mortality of pigs is associated with higher stocking densities. The impact of loading density on the stress burden of slaughtered pigs is also reported by Lambooy and Engel (1991) and Perremans and Geers (1996).

The stress burden of the pigs also increases with the increasing transport distance or transportation time to the slaughterhouse. Perremans and Geers (1996) emphasise the impact of transportation time on the stress burden of pigs. Warriss (1998a) reports that mortality is higher after longer journeys. Werner et al. (2005) found out that transport increases pig mortality, not only transport for longer distances (8 hours journey time), but also transport over very short distances (1 hour).

The ambient temperature during transport of pigs also influences the level of wellbeing in pigs. Warriss (1998a) reports that the rate of mortality is higher at ambient temperatures greater than 10°C. Werner et al. (2005) determined the highest pig mortality during or after transport in Germany between 1999 and 2003 in the summer months of June, July, and August.

The welfare of transported pigs is also influenced by the smoothness of the journey. Bradshaw et al. (1996) registered differences in various ways of riding (rough and smooth) on the ratios of stress burden of the pigs, especially on the plasma concentration of cortisol, beta-endorphin and lysine vasopressin.

Warriss (1998a) also stipulates that feeding has an impact on the welfare of the pigs during transport. Mortality increased in pigs fed within 4 hours of transport. Srinongkote et al. (2003) studied the impact of a diet fortified with L-lysine and L-arginine on the plasmatic levels of cortisol in transported pigs. In the pigs with L-lysine and L-arginine fortified diet, they determined lower plasmatic levels of cortisol than in the pigs with a diet without the addition of L-lysine and L-arginine. The behavioural results indicate a reduction in stress-induced anxiety in pigs fed with L-lysine and L-arginine.

Genetic predisposition is also a significant factor influencing the impact of the stress burden of transport on the welfare of pigs. Warriss (1998a) says that mortality is higher in more stress-susceptible breeds. Similarly, Werner et al. (2005) also emphasise the impact of genetic predisposition on pig mortality in relation to their transport. Murray and Johnson (1998) dealt with the impact of the halothane gene on muscle quality and pre-slaughter deaths. They report that this gene has a major negative influence on the frequency of pre-slaughter deaths. 90% of the PSE (pale, soft, and exudative) condition in Western Canada are caused by factors other than the halothane gene.

In dependence on its extent, the stress burden of pigs causes changes in the behaviour of the animals, changes in haematological and biochemical parameters of the inner environment, causes clinical changes in pigs, is accompanied with injuries and deaths of pigs during transport and shortly after transport is completed, and also has an impact on the meat quality after slaughter.

Changes in the behaviour of the pigs during transport due to their stress burden are reported by Perremans and Geers (1996).

A change in haematological ratios due to the stress burden in pigs during transport is reported by Warriss (1998a). He says that the increased packed cell volume is being determined.

Changes in the biochemical parameters in pigs due to their transport to the slaughterhouse are reported by Warriss (1998a). Increased circulating

concentration of catecholamines, cortisol and creatine phosphokinase were registered. Bradshaw et al. (1996) found out the effects of road transport on plasma concentration of cortisol, beta-endorphin and lysine vasopressin in pigs. They ascertained that transport led to changes in the plasmatic levels of cortisol, beta-endorphin and lysine vasopressin. Kim et al. (2004) dealt with the differing levels of glucose concentration in the blood, creatine kinase (CK) and lactate dehydrogenase (LDH) as indicators of transportation stress. The concentrations of glucose, CK and LDH increased after loading and declined to the resting levels after lairage. The concentrations of CK and LDH were greater in the 3 h vs. 1 h transportation group. The LDH concentration was less in the low than in the medium or high density groups. Saco et al. (2003) ascertained the impact of the duration of pig transportation on the acute phase proteins and cortisol levels. They say that short-duration transport did not modify the levels of acute phase proteins, whereas cortisol was increased just after transport. After long-duration transport, acute phase proteins in serum were increased and cortisol levels were not increased. They postulate that the combination of acute phase proteins and cortisol levels could provide valuable information on the welfare problems related to transport.

Of the clinical changes in relation to the manifestations of the stress burden in pigs during transport, Warriss (1998a) reports an increase in heart rate, and sometimes there is evidence of dehydration. Perremans and Geers (1996) report an increase in heart rate and body temperature.

During transport of pigs to the slaughterhouse, there are also pig deaths and injuries. Warriss (1998a) reports that mortality during transport ranged from 0.1 to 1.0% in different European countries. Von Altrock and von Holleben (1999) dealt with the sudden deaths of pigs during transport. They state that as a result of the stress burden of pigs, the development of lactacidosis and cardiac shock, there is a level of pig mortality during transport of about 0.4% of the animals. Fischer (1995) says that transport is always a stressful factor for animals. The transport conditions influence the well-being of the animals, have an impact on the number of animals dying during their transport and also have an impact on damages to the bodies of the slaughtered animals. Kozak et al. (2004) pointed out the occurrence of non-movable pigs for the reason of unsuitable pig treatment during transport as well as in breeding.

The level of welfare in relation to the transport of pigs to the slaughterhouse also has an impact on the carcass and meat quality (Troeger, 1995). Troeger reports that the quality of the product can be reduced by mechanical damage to the animals during transport, and by the development of processes as a result of the stress burden in the pigs leading to the occurrence of decreased meat quality. This damage to the animals is then reflected in veterinary decision-making about meat edibility and increases the occurrence of inedible meat by reason of a deviation of the meat from its sensorial characteristics, as reported by Kozak et al. (2003). The impact of loading density on the quality of slaughtered pig meat was established by Lambooy and Engel (1991). Similarly, Schutte et al. (1994) say that shortcomings in pig meat quality are given by shortcomings in pig treatment. They say that the worst damage is often connected with the transport conditions. These are influenced by loading and unloading, loading density, the design of the vehicle, the manner of travelling and the length of the journey. Kim et al. (2004) propose that the incidence of a pale, soft, and exudative (PSE) carcass was the greatest in the high-stocking density group. The results suggest that the medium-density may be preferable to the low-density in the long-distance transport. Guardia et al. (2004, 2005) dealt with the risk of PSE and DFD meat in relation to transportation times and stocking density during transport. Warriss (1998a) reports that longer transportation times lead to the increased occurrence of dark, firm, and dry meat (DFD) in pigs.

The ratio of ensuring the level of welfare during transport of animals can be the numbers of animals that have died during transportation, and in the slaughterhouse shortly after transport is completed. Therefore, the aim of our work was to find out the mortality rate in pigs in relation to transport to the slaughterhouse in the Czech Republic in the period from 1997 to 2004, to ascertain the impact of the transport distance on the mortality of these pigs, and to find out the impact of the different seasons by the individual months on the mortality of these pigs during their transport to the slaughterhouse.

MATERIAL AND METHODS

In the period ranging from 1997 to 2004, transport of pigs to the slaughterhouse, in terms of the

protection of animals against cruelty, was monitored in the Czech Republic. The inspectors of the State Veterinary Administration of the Czech Republic recorded the numbers of pigs transported to the slaughterhouse for normal slaughter. The veterinary inspectors recorded the mortality in these pigs in relation to transport, i.e. the number of pigs having died directly in the transport means or having died in the slaughterhouse after transport. The data for the whole Czech Republic was collected in database form in the Information Centre of the State Veterinary Administration. The data was analysed with a programme specially created for these purposes, which generated upon request from the created database the reports about the numbers of transported pigs having died and converted them into Excel format for further statistical processing. The data concerning pigs fed for slaughter in the slaughterhouse was analysed (fattening pigs), the data concerning small sows, sows and boar kept for breeding and now excluded from breeding and slaughtered in the slaughterhouse was not analysed. Transport of pigs for emergency slaughter was not monitored, because in this case there are usually transported pigs that are unhealthy and any possible losses of these pigs could be connected to the on-going illness, and not to the impact of transport to the slaughterhouse.

The impact of the transport distance on pig mortality in relation to transport to the slaughterhouse, was determined in such a way that the transport distances were divided into transport distances up to 50 km, 51 km to 100 km, 101 km to 200 km, 201 km to 300 km, and above 300 km. For these transport distances, the average annual numbers of transported pigs and the average annual numbers of pigs having died in absolute numbers and percentages were calculated.

Seasonal impact, shown by the individual months on the mortality of the pigs during their transport to the slaughterhouse, was determined in such a way that for the individual months for the whole monitored period, the average numbers of transported pigs and the average numbers of pigs having died in absolute numbers and percentages were determined.

In cooperation with the Czech Meteorological Institute, the monthly average values of ambient temperatures at 7 a.m. from two typical places of animal road transport were determined (the locality of Olomouc and the locality of Tuhan).

The results were statistically processed by the Excel computer programme with the statistical calculations module.

RESULTS

Out of the total number of 33 912 125 monitored slaughter pigs transported to the slaughterhouse in the Czech Republic in the period from 1997 to 2004, 36 321 pigs died.

The average annual number of pigs having died, and the impact of the transport distance on pig mortality in relation to transport to the slaughterhouse are shown in Table 1 and Figure 1.

It follows from Table 1 and Figure 1 that for pigs the level of mortality in relation to transport to the slaughterhouse determined altogether for the whole period was 0.107% ± 0.013%. The impact

Table 1. Average number of pigs having died in relation to their transport to the slaughterhouse dependant on the transport distance

Transport distance	Number of pigs transported		Number of pigs having died		Percentage of pigs having died	
	average	sd	average	sd	average	sd
<50 km	2 594 875	165 213	1 618	278	0.062	0.007
51 to 100 km	1 019 203	71 574	1 389	218	0.137	0.023
101 to 200 km	384 326	68 875	836	51	0.223	0.035
201 to 300 km	148 340	39 697	383	153	0.250	0.053
>300 km	92 272	18 874	315	125	0.335	0.113
Total	4 239 016	133 135	4 540	653	0.107	0.013

sd = standard deviation

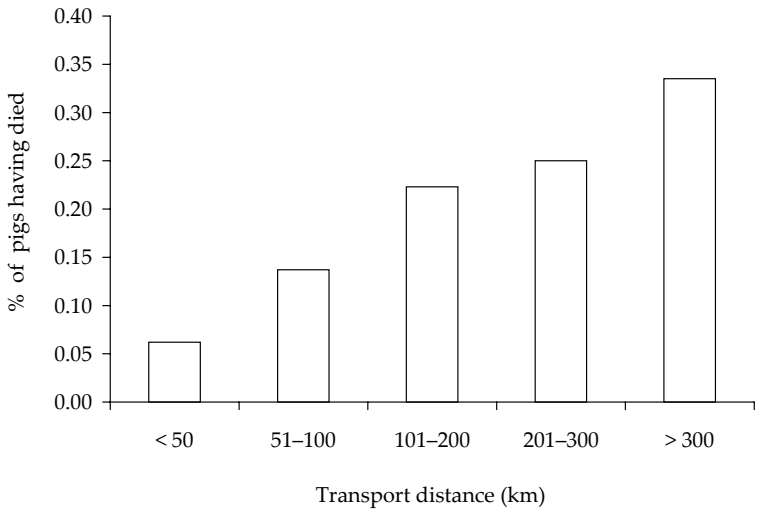

Figure 1. Numbers of pigs having died in relation to transport to the slaughterhouse, depending on the transport distance

of the transport distance on the mortality of the pigs in relation to transport to the slaughterhouse showed itself altogether in such a way that in the case of transport distance up to 50 km, the mortality level was determined to be 0.062% ± 0.007%, and in the case of long transport distance of over and above 300 km, a considerably higher mortality was determined, up to 0.335% ± 0.113%.

The impact of the season, shown by the individual months, on the numbers of pigs having died in relation to transport to the slaughterhouse for the individually monitored transport distances is shown in Table 2 and Figure 2.

It follows from Table 2 and Figure 2, that the season expressed by the individual months has an impact on the number of transported pigs having died. Altogether, the highest losses occur in the summer months, especially in June, July, and August.

The average monthly ambient temperatures at 7:00 a.m. for the period from 1997 to 2004 from the typical places of road animal transport are shown in Table 3 and Figure 3.

It follows from Table 3 and Figure 3 that the highest average temperatures at 7:00 a.m. for the period from 1997 to 2004 from the typical places of road animal transport were determined in the summer

Table 2. Average monthly numbers of pigs having died in relation to transport to the slaughterhouse

Month	Number of pigs transported		Number of pigs having died		Percentage of pigs having died	
	average	sd	average	sd	average	sd
January	344 323	24 873	369	58	0.107	0.011
February	329 837	20 426	355	53	0.108	0.014
March	391 207	29 441	406	49	0.104	0.012
April	355 747	14 559	377	47	0.106	0.010
May	358 654	9 736	407	60	0.113	0.015
June	357 005	16 657	414	82	0.115	0.019
July	345 602	34 456	437	133	0.125	0.029
August	338 703	12 420	404	57	0.119	0.015
September	341 424	19 744	359	68	0.105	0.016
October	347 851	24 143	349	55	0.100	0.013
November	359 219	15 912	324	47	0.090	0.012
December	368 194	21 335	339	67	0.092	0.016

sd = standard deviation

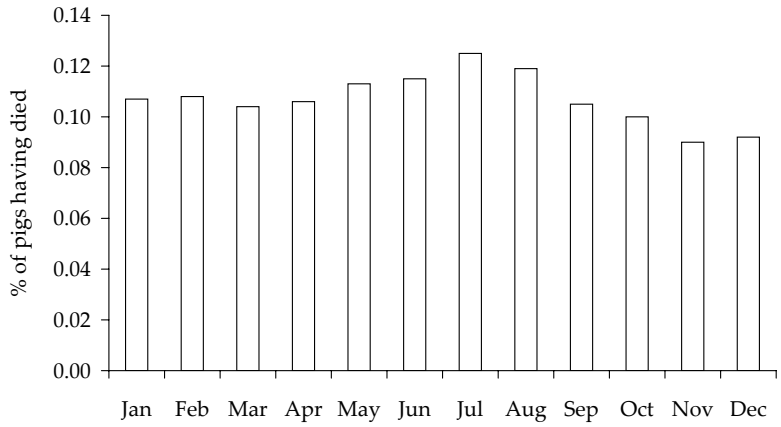

Figure 2. Numbers of pigs having died in relation to transport to the slaughterhouse, depending on the season

Table 3. Average monthly ambient temperatures at 7:00 a.m. for the period from 1997 to 2004 from typical places of road animal transport

Month	Ambient temperature (°C)	
	average	sd
January	–2.6	1.9
February	–0.8	2.6
March	1.8	1.1
April	6.6	1.6
May	13.1	1.4
June	15.8	1.4
July	16.9	1.0
August	16.6	1.0
September	11.1	1.1
October	6.9	2.1
November	2.5	1.8
December	–1.3	2.2

sd = standard deviation

months, especially in June, July, and August, where these values exceeded 15°C.

DISCUSSION

The results established by us confirm that the mortality of pigs during transport to the slaughterhouse constitutes a considerable share of the number of transported pigs. These results support the results reported by Warriss (1998a). In comparison with the results reported by von Altrock and von Holleben (1999), the level established by us is lower; however, during transport for longer distances above 300 km, the mortality level of the pigs in relation to transport to the slaughterhouse established by us approaches nearer to the results reported by the aforementioned authors.

The determined increase in the number of pigs dying with the increasing transport distance shows that longer times of pig transportation deepen the stress burden of the pigs caused by transport. These results support the findings of the authors Bradshaw

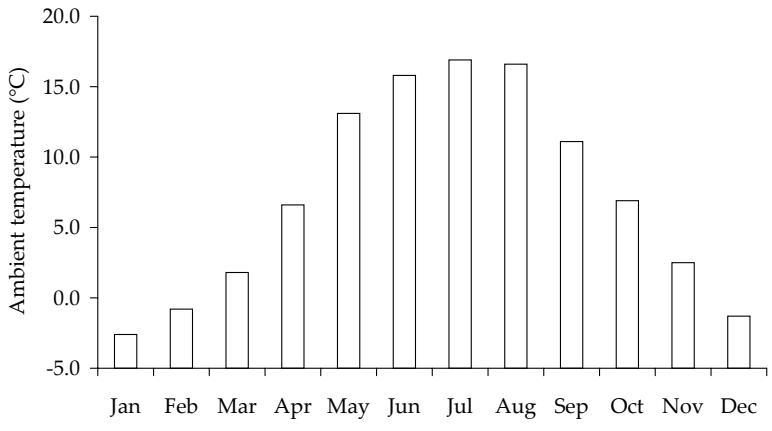

Figure 3. Average ambient temperatures in the individual months of the year for the period from 1997 to 2004 from typical places of animal road transport

et al. (1996), Perremans and Geers (1996), Warriss (1998a), Saco et al. (2003).

The increased mortality of the pigs during transport to the slaughterhouse in the summer months established by us is related to higher ambient temperature in these months. These results support the conclusions published by Warriss (1998a). The ambient temperature at 7:00 a.m. in the summer months, especially in June, July and August in the places of road transport is higher than 15°C, thus negatively affecting the level of welfare and the number of pigs dying during transport to the slaughterhouse. Similar results are also reported by Werner et al. (2005) who determined the highest pig mortality during or after transport in Germany between 1999 and 2003 in the summer months of June, July, and August.

The number of pigs dying during transport to the slaughterhouse can doubtless be decreased. By meeting the requirements of the transport conditions, the pig stress burden can be reduced. They are especially the conditions reported for example by Lambooy and Engel (1991), Schutte et al. (1994), Fischer (1995), Troeger (1995), Perremans and Geers (1996), Geverink et al. (1998), Warriss (1998b), Srinongkote et al. (2003), Kozak et al. (2004), Kuchenmeister et al. (2005), which means especially that the careful and humane treatment of the animals, regular moving and handling, loading and unloading, mixing with unfamiliar conspecifics in the loading space, loading density, ambient temperature, transportation time, careful driving, and feeding pigs before transport. Genetic predisposition also has a significant impact on pre-slaughter pig mortality, as reported by Murray and Johnson (1998), Warriss (1998a), Werner et al. (2005).

The decreasing of the stress burden during pig transport has a positive impact on the meat quality, as follows from the papers by Lambooy and Engel (1991), Schutte et al. (1994), Fischer (1995), Troeger (1995), Warriss (1998a), Kozak et al. (2003), Kim et al. (2004), Guardia et al. (2004, 2005).

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