The relationship between mortality in dairy cows transported for slaughter and season of the year

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Abstract

The level of animal mortality connected with transport for slaughter is reflective of the standard of welfare provided to the transported animals. Increased mortality during transport may, therefore, be a sign of violation of the obligations imposed on breeders and hauliers by the valid legislation regulating the commercial transport of animals. The aim of this study was to determine the mortality rate in culled dairy cows transported to slaughterhouses in the Czech Republic in the period from 2009 to 2014, and to investigate the possible relationship between transport-related mortality in dairy cows and the season of the year in which transport is conducted. The total mortality rate in culled dairy cows transported amounted to 0.207% in the monitored period. A statistically significant correlation was proven between mortality in culled dairy cows and season of the year. The highest mortality rate (0.284%) was recorded in the spring months, while the lowest mortality rate (0.137%) was found in the autumn.

Ambient temperature, dairy cows, mortality, transport

Introduction

Shortcomings in the welfare of transported cattle may lead to the increased occurrence of injury and even immobility, to increased morbidity and mortality in animals weakened by transport stress, to damage to carcasses with adverse effects on meat quality. The effect of transport stress on subsequent meat quality in slaughtered cattle has been studied in a number of works, such as Honkavaara et al. (2003), Villarroel et al. (2003) and Hartung et al. (2003). It is, therefore, extremely important to ensure the consistent observation of the requirements of animal well-being set out in the valid legislation and to reduce the stress load on transported animals as much as possible. The number of animals dying during transport or shortly after arrival may serve as an important indicator of animal welfare during the transportation process.

There are a large number of factors that may have a considerable influence on the welfare of transported animals, such as the age and state of health of the animals, the length of transport, intervals for drinking, feeding and rest, the treatment of the animals during their loading and unloading, the density of animals in the vehicle, the spacing of animals on the bed of the vehicle, the construction and equipping of the vehicle, the way in which the vehicle is driven, the microclimate in the vehicle, etc. The factors that affect the level of stress on transported cattle have been studied in detail by Wikner et al. (2003a). They stated the way in which the vehicle is driven, the handling of the animals during loading and unloading, and the quality of the air in the vehicle to be the most important of these. Wikner et al. (2003b) also studied manifestations of transport stress in cattle transported under various climatic conditions. Villarroel et al. (2003) also concluded that the action of various climatic conditions causes varying degrees of stress in transported cattle. Costa et al. (2003) also observed that external environmental conditions have an impact on the behaviour of transported bulls. The issue of threshold values for optimal climatic conditions that should not be exceeded is often the subject of discussion in

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relation to the thermoregulatory ability of animals (cattle are homoiothermic animals and can adapt to environmental temperature conditions to a certain extent). These threshold temperature values depend on both the type and characteristics of the animals transported (age, category, breed, the condition of the animals) and the conditions of the external environment. The specific effect of transport conditions such as inadequate food and water, high density of animals, high humidity and the speed of air flow on these threshold temperature values has been described (Schrama et al. 1996).

It is understandable that adverse climatic conditions induce temperature stress on transported animals, which is a significant component of the overall stress load associated with transport. The ambient temperature has an effect both on the state of health of the transported animals and on their behaviour in what is, for them, a new and unknown environment, in which they have unwittingly found themselves. Inappropriate climatic conditions also make handling the animals more difficult, particularly their loading onto the vehicle, and also have an indirect effect on the number of injuries and extend the loading period. The ambient temperature particularly affects the microclimate (air temperature, relative humidity and temperature-humidity index) inside the transport vehicle. The possibility of hyperthermia and its impact on animal physiology (fatigue, dehydration, an increased core temperature, etc.) must be taken into particular consideration in connection with the effect of ambient temperature on transported cattle. Temperature stress (and hyperthermia in particular) is a significant cause of animal mortality during transport (Caulfield et al. 2014). Gonzales et al. (2012) found that a rapid increase in the mortality and morbidity rate occurs in animals when the ambient temperature falls beneath –15 °C or rises above 30 °C, accompanied by an increase in the number of individuals that limp or are completely incapable of movement. Malena et al. (2006) recorded the highest mortality rate in fattened cattle in the summer months (particularly in July and August) and winter months (particularly in January and February). Increased mortality was placed in the context of extreme outdoor temperatures and air humidity during these months. Mortality in fattened cattle increases, for example, if the ambient temperature falls beneath 0 °C. In general, we can say that the welfare of transported animals is put at risk by temperatures outside the thermoneutral zone characteristic for the given type of animal, i.e. if the temperature is either too high or too low. Due consideration must also be given to the fact that differences in ambient temperature are not associated merely with the season of the year, but also with the geographic location. What's more, the sensitivity of cattle to temperature conditions differs both in dependence on the category of cattle transported and in dependence on the cattle breed and production type. It is, for this reason, important to consider and define specific circumstances under which transportation is performed when studying seasonal effects on the welfare of transported animals.

The aim of this work was to determine the mortality rate in dairy cows transported to slaughterhouses in the Czech Republic in the period 2009 to 2014 and to determine the influence of the individual seasons of the year on this mortality rate.

Materials and Methods

The numbers of culled dairy cows transported to slaughterhouses in the Czech Republic and the numbers of culled dairy cows that died in connection with this transport were recorded by veterinary inspectors in the years 2009 to 2014. The data comprising figures obtained on all cattle transports conducted in the Czech Republic in the given years were collected in the database of the State Veterinary Administration Information Centre. The data obtained were subsequently exported into the program Excel for statistical processing. Differences in the mortality rate between individual seasons of the year (spring – March, April and May; summer – June, July and August; autumn – September, October and November; winter – December, January and February) were calculated from the results obtained for each year and for the entire period studied. The seasonal effect on the mortality of

culled dairy cows transported to the slaughterhouse was determined on the basis of calculation of the total number of transported dairy cows and the total number of dairy cows that died during a certain season of the year over the whole period studied and calculation of this mortality rate in percent. All the data was analysed with the use of the statistical program Unistat 6.5 (Unistat Ltd., GB). Statistical comparison of mortality rates was performed with the use of a Chi-square test and contingency tables. Fisher's exact test was used if the frequency of the studied characteristic was lower than 5. The significance level was 0.05.

Results and Discussion

In the years 2009 to 2014, we monitored a total of 703 733 dairy cows that were transported to various slaughterhouses in the Czech Republic, of which 1 538 died. The total mortality rate among the culled dairy cows associated with transport was 0.207%.

The effect of the season of the year on the mortality of culled dairy cows transported is given in Table 1. It can be seen from this table that the transport of culled dairy cows took place relatively evenly as far as the number of individuals transported in the individual seasons of the year is concerned, though the numbers of animals dying differed.

Table 1. Number of dairy cows transported to slaughterhouses and number of dairy cows dying as a result of this transport by the season of the year in the years 2009 to 2014

		Spring	Summer	Autumn	Winter
Number of dairy cows	Transported	175184	170732	180865	176952
	Dying	497	346	247	448

The differences in the mortality of culled dairy cows depending on the season of the year are shown in Fig. 1. Transported dairy cows showed the highest mortality rate during the spring months (0.284%), followed by the winter months (0.253%). The mortality rate among dairy cows was statistically highly significantly higher in these seasons of the year than in the summer ($P = 0.002$) and autumn ($P < 0.001$). The lowest mortality rate among transported dairy cows was recorded in the autumn months (0.137%).

All stages of the transportation process (the selection and classification of animals, weighing, assembly, mixing unfamiliar individuals together, driving, loading, etc.) represent a considerable degree of stress for the animals transported. This transport stress is reflected

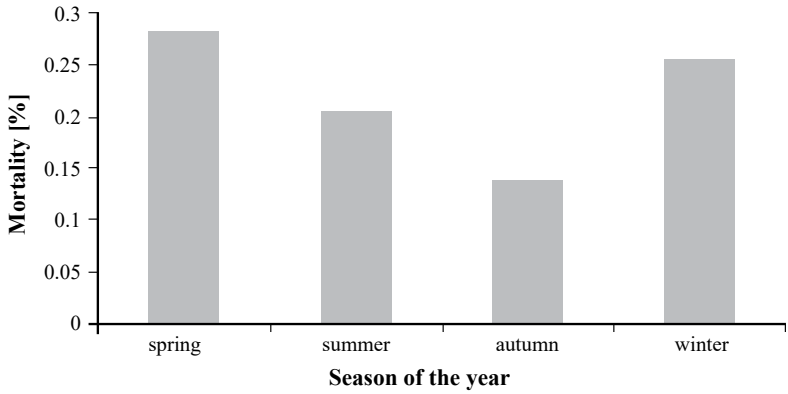

Fig. 1. Mortality in dairy cows in relation to season of the year between 2009 and 2014

in animals by a wide range of manifestations, beginning with changes in behaviour and ending in death or the impaired quality of the animal products obtained, first and foremost meat. Tadich et al. (2000) found an increase in the plasma concentrations of cortisol, glucose and creatine kinase in connection with the long-haul transport of cattle. Wernicki et al. (2003) demonstrated that the effect of transport stress also leads to alterations in the indicators of cellular response. Transport stress induces change to a number of behavioural, physiological, haematological, biochemical, immunological and hormonal parameters in transported cattle and reduces the immunity of the animals and increases the risk of infectious diseases. Behavioural stress may also lead to an increased number of contusions and other injuries (Gallo et al. 2000). As has already been said, excessive stress in cattle during transport may even lead to the death of certain individuals. Norris et al. (2003) stated heart attacks, injury and disease of the respiratory tract to be the principal causes of mortality in cattle during transport. In our study, the total mortality in culled dairy cows associated with transport was 0.207%. Dairy cows are, along with calves, the category of cattle at greatest risk so far as transport stress and its adverse consequences, including mortality, are concerned. This is due, first and foremost, to the fact that dairy cows shipped to the slaughterhouse are primarily those that have been culled from the herd in view of reduced performance.

The expected ambient temperature for the given season of the year must be taken into consideration at the transport planning stage. The issue of ambient temperature and season of the year is closely associated with temperature stress, the microclimate in the vehicle and the technical fittings in the vehicle, in particular the ventilation system. The microclimatic conditions inside the vehicle play a fundamental role in determining the level of transport stress (Swanson and Morrow-Tesch 2001). In addition to the ambient temperature, a number of other factors, such as the density of animals in the vehicle, the air flow and factors associated with the animals such as breathing, sweating and excreting, may have an effect on the microclimatic conditions inside the vehicle (temperature, relative humidity, the temperature-humidity index – THI). The aggregate action of all these factors may either increase or decrease the volume of heat and humidity in the vehicle (Curtis 1993). Goldhawk et al. (2011) looked for a correlation between the density of animals and the microclimate in the vehicle in the summer, and reached the conclusion that the best indicator for predicting the microclimatic parameters inside the vehicle is not the density of animals in the vehicle but the ambient temperature. These findings are fundamental from the viewpoint of monitoring the microclimatic conditions inside the vehicle and allow transporters to better manage and organise the transportation of cattle under demanding climatic conditions.

Teke (2013) studied the degree of body weight loss and the mortality rate in cattle subjected to long-haul transport; he recorded the highest degree of body weight loss in transported animals in the summer (August: 8.39%) and in the winter (December: 7.27%), i.e. in seasons in which the ambient temperature is outside the thermoneutral zone for cattle. An increased occurrence of adverse impacts on the welfare of the animals (mortality, immobility and limping) was also recorded when the ambient temperature fell beneath –15 °C or rose above 30 °C. In their study, Malena et al. (2006) also confirmed that the season of the year has a significant effect on the mortality rate in transported fattened cattle, in spite of the fact that fattened cattle is the category that is most robust in respect to the action of transport stress. In their study on mortality in dairy cows transported to the slaughterhouse, Večerek et al. (2006) came to the conclusion that cooler periods (November, December, January, February, March and April) had a more negative impact on animal welfare than warmer periods (May, June, July, August, September and October), although the difference in mortality among dairy cows between cooler and warmer periods was not statistically significant. In our study, we recorded the highest dairy cow mortality in connection with

transport in the spring months, followed by the winter months. Our conclusions go some way to confirming the finding published by Babcock et al. (2013) who sought a correlation between season of the year and the risk of the death or discarding of cattle transported for fattening. Their observations indicated that cattle transported during the spring or summer (March – September) were exposed to a significantly higher ($P < 0.05$) risk of death or discarding than cattle transported in the autumn and winter (November – February). Similarly, Cernicchiaro et al. (2012) also reached the conclusion that the fluctuations in temperature generally observed in the autumn and early spring may affect the state of health and yield of cattle in which weight loss was seen as a result of long-haul transport.

In the past, the effect of ambient temperature on transported cattle (particularly dairy cows) was discussed primarily in connection with the risk of overheating and its physiological consequences such as fatigue, dehydration, increased core body temperature, etc. In view of the fact that cattle transported under European conditions are generally bred for high yield, their metabolism produces a large amount of heat, for which reason hyperthermia is stated as a frequent cause of death in transported cattle because European breeds show poor tolerance to high temperatures inside the vehicle (Appleby et al. 2008). An additional burden is also often placed on the metabolism of dairy cows by lactation, which makes this category of cattle particularly susceptible to overheating, and the transportation of dairy cows, and cattle in general, should therefore not take place on particularly hot days or particularly hot parts of the day. A sufficient amount of water must, in any case, be provided for the transported animals. Gonzalez et al. (2012) have uncovered a synergistic effect between the period of transport and ambient temperature that results in a faster weight loss in the transported animals if the cattle are transported over a long distance at a high ambient temperature. Temperature stress may also affect the metabolism of individual organs and muscle tissues. These changes may then persist after slaughter, having an unfavourable effect on the quality of the meat obtained (DFD meat) (Gregory 2010) and, thereby, the economic profit of breeders.

In view of the fact that our study recorded the highest mortality rate among transported dairy cows in the spring, followed by the winter, it can be stated that transporting dairy cows in the summer months in the Czech Republic does not represent at the present time a great risk from the viewpoint of welfare, since the unfavourable effects of high temperatures are already well known and transporters are capable of effectively taking them into consideration. Our study also did not confirm that transport during the cooler months represented a greater risk to the welfare of the transported animals than transport in warmer months. This finding is in contradiction of the conclusions reached by the study conducted by Villarroel et al. (2003) which indicate that transport in the winter is more stressful for animals than transport in the summer. As far as mortality in dairy cows associated with transport is concerned, the spring would currently appear to be the most problematic season of the year in the Czech Republic.

Mortality in dairy cows during transport can be reduced if all the legislative demands for the welfare of transported animals are consistently observed (i.e. animals in good condition being transported, correct loading and unloading techniques, sufficient rest intervals, the correct design and equipping of the vehicle, an appropriate microclimate in the vehicle, the necessary expertise on the part of the driver, etc.). If we compare our results with the conclusions of previous studies (e.g. Večerek et al. 2006), which have generally stated an increased mortality rate in cattle during transport connected, first and foremost, with temperature extremes, it is evident that a certain shift has occurred. At the present time, the risks associated with extreme temperatures would seem to be well managed, which in practice means that transport conditions have, in this regard, been appropriately adapted to the demands placed by the individual seasons of the year. In our study, we recorded the highest mortality rate among transported dairy cows in the spring months, followed by

the winter months. The reason may be the poorer quality of feed at the turn of winter and spring, the weakened immunity in cattle after the long winter and the increased occurrence of respiratory illnesses in the spring.

Conclusions

Our results differ from the conclusions of previous studies in terms of the correlation between the mortality rate in transported dairy cows and the season of the year. We recorded the highest mortality rate in transported dairy cows in the spring months (other studies tend rather to associate higher mortality with periods of extreme temperatures, i.e. the summer and winter, when temperatures lie outside the thermoneutral zone). Mortality in dairy cows during transport can be reduced still further if all the demands of animal welfare during transport are consistently observed. In order to prevent increased animal mortality in the spring months, it is necessary to improve the quality of feed given during that period and to perform continual checks on the condition of the animals to ensure they are capable of handling transport stress successfully.

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