Transportation of beef cattle to slaughterhouses and how this relates to animal welfare and carcase bruising in an extensive production system

SM Huertas*,† AD Gil†‡, JM Piaggio†‡ and FJCM van Eerdenburg§

1 Instituto de Biociencias Veterinarias, Facultad de Veterinaria, Universidad de la República, Lasplaces 1550, CP 11600, Montevideo, Uruguay
2 Unidad de Epidemiología, Ministerio de Ganadería Agricultura y Pesca, Constituyente 1476, CP 11200, Montevideo, Uruguay
3 Department of Farm Animal Health, Faculty of Veterinary Sciences, Utrecht University, Yalelaan 7, 3584 CL Utrecht, The Netherlands
* Contact for correspondence and requests for reprints: stellamaris32@adinet.com.uy

Abstract

The objective of this study was to evaluate conditions during transport and their effects on welfare and carcase bruising of beef cattle in Uruguay, a country with an extensive, pasture-based, production system. Twelve abattoirs were visited periodically during two years (2002–2003) and 448 trucks were inspected on arrival. The state of vehicle maintenance was deemed ‘unacceptable’ for the transport of animals in 16.5 (± 3.2)% of cases and most of the vehicles (99.1 [± 0.1]%) had a ‘guillotine-type’ door at the rear end. Both characteristics showed a significant association with the presence of carcase bruising. No overall significant difference was found with the year of vehicle manufacture (24.6 [± 0.2]% before 1990), the presence of rollers bars in 51.3 (± 0.1)% of the trucks on one or both sides of the doors, and the working experience of the men who transported the cattle (> 10 years). The average distance travelled with the animals loaded onto trucks was 240 (± 9) km and the mean journey length was 305 (± 7) min (5 h). A statistically significant effect of the distance travelled and the state of the roads on the occurrence of bruising was found. The use of devices to force animals to move, such as: electric prod (75%), sticks (3%), loud shouts (40%) and a combination of all of the above were positively correlated with bruising. After slaughter, carcase bruising was identified, quantified, and classified into three degrees of muscle injury. From 15,168 beef cattle observed, 60.0% (9,106) had at least one injury. Of the injured carcases, 33.1% (3,015) had one bruise, 25.1% (2,289) had two bruises, 16.2% (1,474) had three bruises and 25.6% (2,328) four or more bruises. Transporting animals in a humane fashion will reduce the amount of bruising on carcases, thereby increasing both the welfare of beef cattle and the profitability of the beef industry in Uruguay.

Keywords: animal welfare, beef cattle, carcase damage, extensive production system, meat quality, transport

Introduction

The transport of live animals is usually a major stressor. One has to realise that the majority of cattle are transported at least once in their lifetime either to slaughter, auction markets or to other farms (Weeks et al 2002). Trucks are the most common vehicles for transportation of beef cattle. Besides the issue of welfare, many studies report a strong relationship between pre-slaughter cattle management and carcase damage (Grigor et al 1997; Knowles 1999; Knowles et al 1999). Loading, stocking density, standard of driving and road condition are all important factors in relation both to animal welfare and meat quality (Tarrant et al 1992; Ruiz de la Torre et al 2001). In addition, Grandin (1989), as well as studies developed by Villarroel et al (2001) and Gallo et al (2003), established that travelling for long distances can cause stress and physical damage in animals. Weight loss, traumatic lesions or (in extreme cases) death can be a consequence of inadequate management concerning transport (Knowles et al 1993, 1994), resulting in substantial financial losses.

The objective of this study was to evaluate transport conditions and their effects on welfare and the presence of bruising in beef cattle.

Materials and methods

This study was performed in Uruguay, a South American country with an extensive, pasture-based, production system for beef cattle, consisting mostly of European breeds (Hereford and Angus and their crosses). Of all the slaughterhouses licensed by the Livestock, Agriculture and Fisheries Ministry and authorised to export to the EU and North America, 12 abattoirs were visited periodically during two years (2002–2003). These represented 85% of total beef cattle slaughter in Uruguay. If there was a full day of slaughter activity in a slaughterhouse, all the trucks that came in that day were included in the study. If all the...
animals from one particular truckload could not be traced for the whole procedure, this truckload was excluded from the data analysis. In all trucks and for all animals the following parameters were obtained via a detailed questionnaire which included the following: vehicle data (year of manufacture; degree of maintenance; door characteristics); estimated loading and unloading time; devices used to force animal movement (electric devices, sticks); road and weather conditions during trip; estimated journey time; problems during the trip; and profiles of truck drivers.

In order to describe the degree of maintenance, vehicle characteristics were assessed, with trailers showing broken parts on the walls, the presence of sharp protrusions, broken floors and defective doors all considered ‘unacceptable’. The state of loading facilities were considered ‘unacceptable’ if the lateral walls had broken parts, it had a very steep slope and/or sharp protrusions were present. Road conditions were registered according to the truck drivers’ opinion: taking ‘good’ to specify a paved road in good condition, ‘unacceptable’ to mean unpaved but not bumpy and ‘bad’, as unpaved, bumpy and with many curves.

Truck drivers were also questioned about their general experiences and time spent in their present occupation.

The team of researchers recorded information such as: time required for unloading (in minutes); fallen animals and weather conditions at the time of unloading as well as the presence of horned animals and different categories of animal (ie heifers, cows, calves, bulls) in the same load.

After slaughter, carcase damage was identified, and quantified by area and three degrees of muscle injury. Each bruise was classified according to depth of damage: degree 1, only superficial tissue is involved; degree 2, fat, connective tissue and muscular tissue is involved; and degree 3, very deep (affecting bone and muscle), partial or total condemnation of carcase.

Data analysis
Descriptive analysis was performed in order to obtain estimators from each variable considered. The association between carcase bruising and truck characteristics, the characteristics of loading and unloading of animals and the devices used to move the animals (raw categorical variables) were tested with $\chi^2$ with a significance level of 0.05. Continuous variables such as distance and time of the journey, amongst others, were categorised. To study the association between carcase bruising and other variables, bruises were recorded as: No Bruises = no bruises plus degree 1, and Bruises = degree 2 plus degree 3.

All data collected were analysed using the statistical package, Intercooled Stata 8.0 (2003).

Results
Table 1 shows the associations between the different factors affecting the animals at pre-slaughter stages and percentages of carcase bruising.

Truck characteristics
The degree of vehicle maintenance was deemed ‘acceptable’ for transporting animals in 83.5 (± 2.7)% of cases. The remainder (16.5 [± 3.2]%) were found to be in an ‘unacceptable’ condition, having one or more of the defects mentioned earlier. An association between carcase bruising (24.53%) and animals exposed to this ‘unacceptable’ level of truck condition of the trucks was found ($\chi^2 = 3.93, P > 0.05$).

The presence of a ‘guillotine-type’ door at the rear end (99.1 [± 0.1%]) of trucks also showed a difference ($\chi^2 = 4.81, P < 0.05$).

No significant overall differences were found between the year of manufacture of the vehicles that transported cattle (24.6% before 1990; 29.8% between 1990 and 1995 and 45.6% were newer, made after 1995) and the presence of roller bars (51.3 [± 0.1%]) in one or both sides of the doors of the trucks.

Road characteristics
An effect of the average distance travelled, 240 (± 9) km (CI of 95%, from 222 to 258 km), which means a time for a journey of 305 (± 7) min (CI of 95% from 291 to 319 min), on the occurrence of carcase bruising was found ($\chi^2 = 5.96, P > 0.05$).

According to the opinion of truck drivers, in 18.1 (± 6.5)% of cases the roads could be classed as being in ‘bad condition’ and a correlation was found with bruising ($\chi^2 = 3.00, P > 0.08$).

Characteristics of loading and unloading
The use of devices to force animals to move, such as electric cattle prods (75%), sticks (3%), loud shouts (40%) and a combination of all of the above were positively associated with bruising ($\chi^2 = 9.75, P < 0.002$).

Furthermore, no overall significant differences were found between the following variables (according to the opinion of truck drivers) and carcase bruising: loading and unloading time of greater than 10 and 15 min, respectively and bad loading facilities at the farm (5.3 [± 1.0]% of the cases).

Animal characteristics
A positive correlation was found between the presence of at least one horned animal in the truckload (83.3 [± 2.6]%) and the occurrence of carcase bruising ($\chi^2 = 6.75, P > 0.009$).

No significant differences were found between bruising and the mix of different age-groups and sexes (ie young animals, steers, bulls, cows) in the truck. Also, no significant difference was found in relation to the working experience of the men who transported the cattle (14 [± 0.5] years).

Carcase bruising
From 15,168 beef cattle observed, 60.0% (9,106) had at least one injury. Of the injured carcases, 33.1% (3,015) had one bruise, 25.1% (2,289) had two bruises, 16.2% (1,474) had three bruises and 25.6% (2,328) four or more bruises.
Table 1 Associations of different factors affecting animals at pre-slaughter stages and carcase bruising.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Exposed Bruises (± SEM) (%)</th>
<th>Not exposed Bruises (± SEM) (%)</th>
<th>$\chi^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Truck related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad maintenance of truck</td>
<td>24.53 (± 4.18)</td>
<td>17.22 (± 0.36)</td>
<td>3.93</td>
<td>0.048</td>
</tr>
<tr>
<td>Presence of guillotine doors</td>
<td>17.52 (± 0.36)</td>
<td>10.83 (± 2.48)</td>
<td>4.82</td>
<td>0.028</td>
</tr>
<tr>
<td>Presence of roller bars</td>
<td>18.41 (± 0.57)</td>
<td>17.26 (± 0.57)</td>
<td>2.02</td>
<td>ns</td>
</tr>
<tr>
<td>Trucks older than 10 years</td>
<td>16.76 (± 0.73)</td>
<td>17.92 (± 0.42)</td>
<td>1.83</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Road related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journey duration greater than 5 h</td>
<td>18.48 (± 0.57)</td>
<td>16.61 (± 0.52)</td>
<td>5.96</td>
<td>0.015</td>
</tr>
<tr>
<td>Bad quality roads</td>
<td>21.92 (± 2.80)</td>
<td>17.43 (± 0.36)</td>
<td>3.00</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Loading/unloading related</strong></td>
<td></td>
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</tr>
<tr>
<td>Loading for longer than 15 min</td>
<td>18.34 (± 0.63)</td>
<td>17.05 (± 0.44)</td>
<td>2.83</td>
<td>ns</td>
</tr>
<tr>
<td>Unloading for longer than 10 min</td>
<td>16.11 (± 1.35)</td>
<td>17.55 (± 0.38)</td>
<td>0.21</td>
<td>ns</td>
</tr>
<tr>
<td>Bad loading facilities</td>
<td>18.36 (± 0.37)</td>
<td>17.25 (± 1.46)</td>
<td>0.57</td>
<td>ns</td>
</tr>
<tr>
<td>Devices to move animals</td>
<td>24.70 (± 2.74)</td>
<td>17.27 (± 0.36)</td>
<td>9.25</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Animal related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of horned animals</td>
<td>17.78 (± 0.39)</td>
<td>15.13 (± 0.89)</td>
<td>6.75</td>
<td>0.009</td>
</tr>
<tr>
<td>Mix of categories</td>
<td>17.40 (± 0.80)</td>
<td>16.94 (± 0.44)</td>
<td>0.26</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Driver related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Greater than 10 years experience</td>
<td>17.49 (± 0.50)</td>
<td>17.52 (± 0.53)</td>
<td>0.00</td>
<td>ns</td>
</tr>
</tbody>
</table>

* Chi-square analysis performed with one degree of freedom.

Discussion

Truck characteristics
At the time of this study, no data were available related to the number and characteristics of the vehicles transporting live animals in Uruguay. Almost 25% of the vehicles were older than 10 years when the study was carried out but no significant association was found with carcase bruising. Almost all the vehicles had vertical doors (guillotine-type) in the back of the cage and there was an association between this and carcase bruising as well as the 16% of trucks badly maintained. Tarrant and Grandin (2000) reported an increase in carcase bruising when animals were transported in vehicles in bad condition and with faulty doors. Fifty-three percent of the trucks had vertical rolls in one or both sides of the door. These rolls prevent abrasions when an animal passes the opening and is pushed against the side of the opening by other animals. However, no statistical correlations were found related to carcase bruising in the present study. Perhaps there were other factors confounding this potential association.

Routes travelled
According to the truck drivers interviewed, 19% of trips were on bad condition routes. This fact would explain, in part, the association with the presence of traumatic bruises in carcases at slaughter time. This is in accordance with Ruiz de la Torre et al (2001) who report a decrease in meat quality when animals were transported under bad conditions as opposed to being transported via highway. In addition, Villarroel et al (2001) found transport to be a critical factor in animal welfare, but vehicle condition and road state were not found as important as long distances and the driving manoeuvres; the latter two proving to be very important in causing traumatic bruising. Further studies are needed to determine these parameters for the Uruguayan situation.

Truck drivers’ characteristics
Apparently the state of the roads has a far more significant impact on the presence of bruising compared to driving experience. However, it is clear that careful driving and quiet handling will reduce the amount of sudden movements of the animals, thereby reducing the risk of animal injury.

Journey distance and time taken
In the present study, despite the fact that the average distance travelled (240 ± 9 km) does not appear to be very long, an effect was found on the occurrence of carcase bruising. In contrast, Hoffman et al (1998) reported that transport distances shorter than 325 km did not increase the presence of traumatic bruising. Gallo et al (2000, 2001, 2003) report the presence of one or two fallen animals, 50% more bruising and a reduction in live weight in steers trans-
ported for 12, 24 and 36 h. Moreover, Fernandez et al (1996) report that long distances have a negative effect on meat quality in calves. In the present study, 60% of trips were shorter than 250 km but bruising at the carcase level was still observed.

Loading facilities

The time required for loading, as stated by the truck drivers, was, on average, 18.6 (± 0.8) min whereas for unloading it was 5.4 (± 0.2) min; almost four times quicker. This can be explained by the fact that it is easier for the animals to descend from a vehicle (to escape) than to enter a dark cage such as the truck (Grandin 2000). No significant differences were found between these variables and carcase bruising. However, in this study, loading time was subjective and able to be biased by the truck driver’s perception, ie that longer loading times imply better handling of the animals. These data justify a more detailed study as several authors agree that the welfare of the animals is affected by loading, unloading and transport (Broom 1986, 1991; Gallo et al 2003).

Devices to force animal movement

The use of devices, such as sticks and electric cattle prods, in almost 60% of the cases showed a positive correlation with the presence of bruising and denotes that improper handling of the animals remains one of the most important factors to consider in relation to animal welfare as well as increasing the presence of bruising (Grandin 1991, 2000). This same author, (Grandin 1996), states that cattle handled roughly had almost twice as many bruises than those handled gently. In Uruguay, as with a number of other countries, there is a traditional way of handling the animals which can be considered rough and, in some cases, extremely so. However, in the present study, the manner in which devices were utilised was not determined, only if they were used or not. Further studies are needed to elucidate the details of the current use of these devices and the training of drivers.

Other characteristics observed

According to Broom (2005), mixing animals of different origins promotes fighting and increases bruising due to the resultant social interaction. However, of all the loadings observed in this study, 25% included animals of different sex and age within the same vehicle, but no statistically significant associations were found. In that sense, Yeh et al (1978) found no evidence that mixing of categories increases injuries in the animals. Eighty-four percent of the loads studied included horned animals and a positive association with bruising was found. Shaw et al (1976) and Ramsay et al (1976), report that the transport of horned animals increases the amount of bruising in carcases. Castro and Robaina (2003) state that there is more than twice the number of bruises when horned animals are transported compared to polled animals. However, dehorning the animals prior to transport does not seem an adequate solution to this problem.

Human-animal interaction

At the level of industry, some events increase the risk of damaging the physical integrity of the animals, such as slides or falls on the way towards slaughter. These events are due, in general, to incorrect maintenance of facilities, as reported by Gonyou (2000) and Grandin (2000). This last author insists that the way to decrease this problem is by making permanent audits at all stages of the handling of the animals, from the unloading of vehicles to the slaughter itself. Lensink et al (2000, 2001), stated that animals accustomed to the presence of people have a better quality of life, are less stressed and undergo less injuries due to accidents. In Uruguay, beef cattle are raised in an extensive way and familiarising animals with humans is, therefore, a difficult task. However, one should take this into account when dealing with these animals and treat them quietly and with patience. Transporting animals in a proper manner will reduce the amount of bruising to carcases thereby increasing both the welfare of beef cattle and the profitability of the beef industry in Uruguay.

Animal welfare implications

Both transport and handling practices indicate that the welfare of beef cattle was affected. Carcase bruising might be diminished by good handling practices which include transport conditions and distances travelled. The fact that a reduction in bruising would also prevent economic losses is an important factor in helping improve the welfare of beef cattle during transport.

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