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Review: Transportation of commercial finished cattle and animal welfare considerations

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ABSTRACT

The purpose of the following report was to review and present the literature focused on the topic of current industry practices of land transport of finished cattle, primarily within the United States and Canada. This review was broken down into 5 areas: (1) microclimate, (2) loading density, (3) duration of transport, (4) quality of transport, and (5) animal behavior. All of these factors play a role in animal welfare and have been shown to influence post-transport animal health and carcass quality. Certain stressors such as loading density and duration are more understood than others and are easier to manipulate, whereas other stressors, such as microclimate and human factors, require more research to fully understand the magnitude and interactions of the stressors and how to address them. Improving the overall transport process ensures the safety and well-being of the animal and the quality of the carcass, providing both an ethical and economic benefit.

Key words: animal welfare, carcass quality, finished cattle, transport

INTRODUCTION

The United States' beef industry is constantly urged to improve in the areas of food quality, animal welfare, trade, traceability, and product safety (Bosona and Gebresenbet, 2013). However, there are several factors that affect the outcome of these goals, each with its own set of standards, regulations, and industry practices. For instance, carcass quality and animal welfare concerns are 2 primary considerations that are directly related to transportation factors. Improvements can be made by better understanding how these specific aspects of transporting cattle at all stages of life, but especially finished cattle, affect cattle well-being and profitability.

Cattle, on average, are transported 4 to 6 times during their lifetime (González et al., 2012c). The general flow of cattle starts with the animals being born on a cow-calf operation, weaned, and hauled to a sale barn where they are sold and transported to a stocker operation, grown for a period of time, transported to a feedlot for the finishing phase, and then finally transported to a slaughter facility. The United States slaughtered 28.8 million cattle and produced 10.4 billion kilograms of beef in 2015 (USDA, 2016). To achieve these numbers, approximately 934,000 loads of cattle are transported to slaughter facilities each year, with the weight of the animals ranging from 500 to 725 kg (Fike and Spire, 2006). One study conducted in North America evaluated the effects of long-haul transport (>400 km) on over 14,000 loads of cattle and reported that the average time the animals spent in transport was 15.9 h, the average distance of these trips was 700 km, and the internal trailer temperatures ranged from −42 to 45°C (Hicks, 2012).

Transportation is considered one of the most stressful events that cattle must endure during their lifetime (Grandin, 2001; Kettlewell et al., 2005). The overall transportation process includes gathering and holding cattle before and after loading, loading time, time spent on the trailer (stationary and moving), waiting to unload at the destination, and finally unloading. The effects of stress vary according to the actual stressor as well as the magnitude and frequency of the source of stress (Marahrens et al., 2011). The main areas of stress during transport can be broken down into 5 primary factors: (1) microclimate, (2) loading density, (3) duration of transport, (4) the quality of transport, and (5) the behavior of the animal and those around it. Each of the areas can be broken down into subcategories that can influence the animal's performance and many need further research to fully understand the stress the animals endure during transport.

The 3 main aspects of animal welfare are (1) physical functioning, (2) naturalness, and (3) subjective states, meaning that the animals are kept healthy, allowed to behave as naturally as possible, and exist with minimal negative experiences (Fraser, 2008). Different procedures are taken depending on the age and weight of the animals when they are transported. For instance, trucks hauling calves are more likely to use boards in cold weather to regulate internal temperatures and are able to be loaded in all compartments of the trailer, whereas the nose compartment is often unused when hauling finished cattle because of the height of the animals.

Transportation procedures specific to cattle age, weight, and type tend to yield different results. Animal welfare is

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of utmost importance regardless of age, weight, or even species of animal being hauled, but there are different ideal outcomes for each different category of animal. For instance, health and immunity are the primary focus when transporting calves and feeders, whereas carcass quality is the main objective when transporting market-weight or finished cattle to the slaughter facility. Body weight lost by an animal during transport, also known as shrink, can vary due to factors influenced by the animal's life stage, such as differences in diets, loading densities, and location of feeding facilities in relation to the destination. Because of these variances, this review presents a summary of literature evaluating animal welfare, profitability, and economic factors influenced by transporting finished cattle in the beef industry.

Previous research that evaluated cattle transport systems has contributed to improvements of animal welfare and beef products in the United States (Swanson and Morrow-Tesch, 2001; Fike and Spire, 2006; Cockram, 2007). The beef industry in the United States follows what is called the 28-h law dictating the duration animals may be transported before being offloaded and allowed to rest. The 28-h transport law was first presented as the transport of animals by rail in 1873 and was established as federal regulation for the interstate transport of livestock by the USDA in 1918 (Goding and Raub, 1918). Slight modifications were made that included civil penalties, mainly the inclusion of fines ranging from $100 to $500 for each offense, which were put into effect in 1994 (USDA, 1994). Slow regulation changes and also the improvements made within European Union transportation systems have brought into question animal welfare concerns within the United States and Canada. More recently, a Canadian trailer manufacturing company, HarBra, has made advancements in trailer design by implementing an Italian design (Pezzioli) that is a completely enclosed trailer with ducted air, has adjustable deck height, and is equipped with in situ feeding and watering troughs to improve the quality of animal transportation and to meet European Union regulations. Regardless of means, the results of transportation should be a balance of profitability and welfare of the animal during transport (European Commission, 2001; CEC, 2005). The infiltration of European designs shows there could be grounds for the United States and Canada to reevaluate welfare concerns in transport, while still maintaining economic feasibility.

Microclimate

"Microclimate" is a term used to describe the internal climate of the trailer that the animals are subjected to. Factors that make up the microclimate are heat, humidity, carbon dioxide concentration, ammonia concentration, other noxious fumes, and overall air quality (Randall, 1993; EFSA, 2004). All of these factors can be affected by external ambient conditions such as wind speed and direction in relation to the trailer, loading density, animal

Figure 1. Internal straight deck livestock trailer schematic diagram displaying the separate compartments used to transport cattle.

respiration, defecation, sweating, bedding, boarding, and trailer speed. Modifications to the ventilation and airflow properties could improve the microclimate and animal welfare during transport.

Cattle are normally transported in either a straight deck trailer or a potbelly trailer. A straight deck trailer is divided into 2 or 3 parallel decks with the lowest being straight across from the top of the fifth wheel of the truck to rear axle of the trailer (Figure 1). A potbelly trailer is similar to the straight deck. The lowest deck, also known as the belly, is similar to that of the drop deck trailers with drops right after the rear tires of the truck and before the rear axle, thus dividing the trailer into the back, belly, nose, deck, and doghouse complete with internal ramps for ease of access (Figure 2). Both trailers have either slats or punch holes running along the sides of the trailers for light and air exchange. The natural airflow of a standard potbelly trailer is a passive ventilation system that is driven by internal air buoyancy and pressure gradients around the trailer. As the vehicle moves, air is split to either side of the trailer by the front of the truck, travels past the nose of the trailer, and reattaches to the sides of the trailer toward the rear (Mitchell and Kettlewell, 2008; Figure 3). This results in a zone of strong negative pressure near the nose of the trailer and a lesser zone at the rear, meaning that inlets and air uptake happen in the back end of the trailer and air moves up the length of the trailer over the backs of the animals and exits through outlets in the nose (Ellis et al., 2010; Gilkeson et al., 2016). This effect is so great that outlet temperature can be 16 to 20°C higher than inlet temperature because of heat produced from the cattle that is being carried away, with similar results with carbon dioxide concentration (Muirhead, 1983; Kettlewell et al., 2001b; Ellis et al., 2010). The positioning of the gates and animals in the trailer, as well as external envi-

Figure 2. Internal potbelly livestock trailer schematic diagram displaying the separate compartments used to transport cattle.

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