LIVES NOT STOCK

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING FARMED ANIMALS: PIGS, CATTLE, CHICKENS, AND SHEEP

ANIMAL JUSTICE PROJECT

witness • expose • react

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING FARMED ANIMALS:
PIGS, CATTLE, CHICKENS, AND SHEEP

Written and researched by Dr Helen Lambert BSc Hons, MSc, PhD
Published by Animal Justice Project 2023

ANIMAL JUSTICE PROJECT
witness•expose•react

Animal Justice Project, 27 Old Gloucester Street, London, WC1N 3AX, UK
Charity Trust Number: 1184965 | Registered Company Number: 09335745
animaljusticeproject.com | info@animaljusticeproject.com

EXECUTIVE SUMMARY

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING PIGS

Pigs find all aspects of transportation stressful, but loading is considered to be the most critical (Goumon and Faucitano, 2017). Pigs are often unfit, and therefore find loading to be tiring and stressful (Edwards et al., 2011; Ritter et al., 2009), especially when they are mixed with unfamiliar pigs, as this often leads to aggression and injuries (Goumon and Faucitano, 2017). There are many factors that can worsen their welfare during this process, including the methods in which they are moved, especially if painful electric prods are used (Mcglone et al., 2004).

The welfare of pigs during the journey itself is influenced by many interrelated factors. The total duration of the journey plays an important role, but can also be impacted by other variables, such as the weather and stocking densities (Garcia et al., 2015). Both short and long journeys can negatively impact pigs, and even relatively short journeys of under 4hrs can result in pigs being injured, unable to walk, or dying during a journey (Sutherland et al., 2009). Pigs also show increased levels of stress hormones as journeys increase, as well as physiological indicators of fatigue and muscle damage (Sommavilla et al., 2017; Voslarova et al., 2017). The microclimate in the trailer can also pose significant welfare issues for pigs, as thermal stress can cause considerable suffering and mortalities (Bracke et al., 2020). The numbers of pigs, and the space each pig has, can also impact the microclimate, and the welfare of the pigs, and there is rarely a balance between providing enough space for comfort and proper thermoregulation, and not too much space so that pigs become unstable (Garcia et al., 2015). The unloading process can pose additional welfare issues, especially for fatigued, injured, or ill pigs, as the journey further reduces the coping mechanisms of pigs (Driessen et al., 2013).

Pigs are highly intelligent and sentient beings. They can feel a range of emotions, including fear, stress, pleasure, and excitement (Marino and Colvin, 2015; Proctor, 2012). Pigs are naturally very playful animals, and when unconfined, they will play with objects and other pigs and will chase, run, jump, and flop on the ground just for fun (Horback, 2014). Pigs are very social animals too, and they understand when another pig is in distress and can become distressed themselves (Goumon and Špinka, 2016; Reimert et al., 2017). The transportation process for pigs is highly stressful, as evidenced by the many physiological and psychological effects on their welfare. Given that these are sentient beings, their feelings and experiences are important, and they matter to them and to us.

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING CATTLE

As with pigs, the loading and unloading phases can be the most stressful parts of the transportation process for cattle too (Losada-Espinosa et al., 2018). Being moved on to a truck is often an entirely new experience for cattle, and can be aversive for those who are less familiar with humans, or who have reactive personalities (Grandin and Shivley, 2015). Heart rates and stress hormones are often elevated considerably as a result (Gebresenbet et al., 2012).

The journey poses many more welfare concerns, especially for individuals who are less fit or robust, such as young calves or cull dairy cows with poor body conditions (Schwartzkopf-Genswein et al., 2016). Generally, the longer that cattle are transported, the greater the number of dead and injured animals on the truck (Schwartzkopf-Genswein et al., 2016). Short journeys can also negatively impact cattle welfare, and often result in higher levels of stress hormones, compared with longer journeys (Gebresenbet et al., 2012). Changes to the microclimate in the trailer can be responsible for stress and mortalities during transportation, as cattle are susceptible to thermal stress during journeys (González et al., 2012a). Space allowances can also play a role, and can exacerbate any issues with temperature control, and even cause adverse microclimates as the cattle try to thermoregulate their temperatures (González et al., 2012a; Schwartzkopf-Genswein et al., 2012). The condition of transported cattle varies, and cull dairy cows, who have poor body conditions, are more susceptible to bruising, further emaciation, and being unable to stand by the end of the journey (Cockram, 2020).

The unloading phase is likely to be highly stressful for cattle who are especially fatigued, stressed, or injured during the journey, but studies show that all cattle find unloading stressful, have elevated heart rates, and show fearful behaviour as a result (Bravo et al., 2020; Gebresenbet et al., 2012).

Cattle are social, complex, and emotional animals (Marino and Allen, 2017). They are capable of a wide range of emotions, and they communicate their feelings in many ways, including their ear and tail postures (de Oliveira and Keeling, 2018; Lambert and Carder, 2019). The stress that cattle feel during transportation can have lasting effects on their mood, as cattle can become pessimistic after painful and stressful experiences (Daros et al., 2014; Neave et al., 2013). Cattle are sentient beings, and so the likelihood of them feeling fear, stress, and potentially pain during transportation is a significant ethical concern.

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING CHICKENS

The welfare concerns for chickens who are bred for meat (broilers) and those bred for egg-laying (layers) differ, but both broilers and layer hens typically have poor body conditions, because of the emphasis during breeding for production levels. This can have considerable negative effects on their welfare during transportation (Jacobs et al., 2017a; Vecerkova et al., 2019).

Chickens are commonly caught and held upside down by their legs for loading, and this can cause leg and wing fractures, severe bruising, scratching, muscular damage, and fatalities (Schwartzkopf-Genswein et al., 2012). The birds also show physiological and behavioural signs of significant stress and fear, and the catching process is considered to be the most stressful stage of transportation for chickens (Gerpe et al., 2021).

The journey itself can also introduce welfare issues and is greatly influenced by the chicken's well-being following catching (Schwartzkopf-Genswein et al., 2012). For example, any injuries incurred during catching are likely to be exacerbated during the journey and can reduce the chicken's ability to cope with the stressors of transportation (Jacobs et al., 2017a). Journey duration and the microclimate in the trailer can also have significant impacts on the birds' welfare and are often the factors most likely to cause fatalities (Benincasa et al., 2020). Chickens are highly susceptible to thermal stress and are poorly adapted to cope with the extreme microclimates, which often occur in overcrowded trailers (Cockram and Dulal, 2018).

Chickens are sentient, curious, and intelligent animals, all with unique personalities (Marino, 2017). Chickens can be fearful and stressed, but if given the chance, they can also experience positive emotions like excitement and pleasure (Marino, 2017). The stressors of transportation can have significant impacts both on chickens' physical well-being and also on their mental well-being. The welfare of these sentient, feeling, and emotional beings is negatively impacted by transportation, as they are not adapted to cope with the challenges that transportation pose.

THE WELFARE ISSUES ASSOCIATED WITH TRANSPORTING SHEEP

Sheep are highly sensitive animals and find the experience of transportation to be very stressful (Valkova et al., 2021a). Loading introduces many welfare concerns for sheep and often results in high degrees of fear and stress, as well as physical exhaustion and potential injuries (Messori et al., 2015; Pérez et al., 2018; Wickham et al., 2012). These experiences during loading can then significantly worsen the sheep's experiences during the journey itself.

As with other farmed animals, the main welfare concerns during the journey are the duration of time the sheep are loaded for, the microclimate inside the trailer, and the number of sheep being transported. If a sheep is already highly stressed or injured, then they are less able to cope with these stressful factors, and this can severely impact their welfare (Cockram et al., 2004). Sheep show many signs of stress and poor welfare during transportation, including raised heart rates, high levels of stress hormones, dehydration, and fatigue (Collins et al., 2018; Pascual-Alonso et al., 2017). Sheep are also typically fasted prior to transportation, and the resulting hunger can cause poor moods, making the sheep feel pessimistic and stressed (Verbeek et al., 2014). Transportation can also have long-term effects on sheep, as the stress they experience can impact their mood for some time (Doyle et al., 2011).

Sheep are sentient, complex, individual beings, and their social relationships are important to them (Marino and Merskin, 2019). In fact, sheep can recognise at least 50 different sheep faces for over 2 years (Kendrick et al., 2001). Sheep are also very good at communicating their emotions and do so through their facial expressions and different ear and tail postures (McLennan et al., 2016; Reefmann et al., 2009). Sheep are sensitive animals, and the many stressors they experience during transportation pose considerable risks to their physical and mental well-being.

CONTENTS

1 PIGS

1.1 WELFARE ISSUES ASSOCIATED WITH THE LOADING OF PIGS

Loading is considered to be the most critical stage of transportation regarding the welfare of the pigs involved. Studies have found that pigs have significantly higher heart rates during loading, as well as increased salivary cortisol levels (stress hormones), and increased blood lactate values (a measure of physiological stress) (Bertol et al., 2005; Correa et al., 2010; Edwards et al., 2011, 2010; Goumon et al., 2013b; Hamilton et al., 2004; Ritter et al., 2009).

There are multiple welfare considerations during the loading and unloading process, and various factors such as the weather, stock person techniques, and the facilities and equipment used also play an important role. The loading process involves various stages; first, the pigs are sorted into their home pen, which may involve splitting groups of pigs. Second, the pigs are then moved to the loading area, which may require them to walk long distances. Once there, pigs are often placed into a shipping or pick-up pen, where they may be mixed with unfamiliar pigs. Depending on the system, they may be in these pens for some time, before they are loaded into the truck. At this point, various factors can impact the pigs' experience, including the loading ramp, the moving tools, and the methods used to move the pigs. The following sections discuss the welfare issues involved in each stage of the loading process.

1.1.1 SORTING AND MOVING PIGS FOR TRANSPORT

Farms can apply different strategies for selecting pigs for transport and slaughter. Some may adopt a split-marketing system, where the heavier pigs are removed for slaughter, whereas in all-in-all-out systems, all pigs within the group are removed at once (Goumon and Faucitano, 2017). Regardless of the marketing strategy, most groups of pigs are split at this point into smaller groups to aid with loading (Faucitano, 2018). The pigs are then required to walk long distances from their pen to reach the truck (Ritter et al., 2009). Some argue that this first part of transportation is the most stressful part of the entire transport process for pigs (Faucitano, 2018).

Pigs are highly social animals, and they have complex social hierarchies which are regularly maintained through communication, fighting, and affiliative behaviours (Horback, 2014). Splitting groups of pigs can cause them considerable stress because of the changes in their social environment, which is further exacerbated by the close presence of humans (Goumon and Faucitano, 2017).

As a result, many pigs exhibit physical signs of stress, including open-mouth breathing and skin discolouration, once they are moved from their home pen (Edwards et al., 2011; Ritter et al., 2009). Furthermore, studies have found elevated blood lactate concentrations in the pigs, increased levels of stress hormones, and elevated heart rates, compared with resting pigs, indicating fatigue, physiological and psychological stress (Bradshaw et al., 1996; Correa et al., 2013, 2010; Edwards et al., 2010). These welfare concerns are more considerable when pigs are reared in smaller pens, as they are less fit, and less resilient to the stressful experience of handling (Johnson et al., 2010; Rocha et al., 2016). These effects may also be exacerbated by factors such as feed withdrawal (see Section 1.4.1), and the weather, as summer temperatures can further increase heart rate and the risk of heat stress during this process (Correa et al., 2013). These negative effects may be long-lasting, and the effects of loading can last until slaughter (Correa et al., 2010; Edwards et al., 2011).

1.1.1.1 TOOLS USED TO MOVE PIGS

Electric prods are still legally permitted for use with pigs, although are discouraged in the Code of Practice for the Welfare of Pigs[1]. Despite this, they may be used in order to speed up loading (Faucitano, 2018). However, because the electric prods are painful and distressing for the pigs, they react aversively to them, which slows down the entire process, and creates difficulties for handlers (Mcglone et al., 2004). Common behavioural reactions include panic, resulting in the pigs backing up, slipping, falling, jamming, turning around, vocalising, and attempting to bite the handler (Correa et al., 2010; Dokmanović et al., 2014; Mcglone et al., 2004). Physiological reactions to electric prods include a greater incidence of pigs being unable to walk or stand, higher heart rates, increased blood lactate concentrations, and skin lesions (Correa et al., 2010; Edwards et al., 2010; Faucitano, 2018). Electric prods are ineffective and are widely banned in abattoirs, although they are still permitted for individuals who are reluctant to move (Faucitano, 2018). Electric prods cause pigs pain and distress and also have the greatest potential for being used by non-trained or improperly trained handlers, in place of more skilled techniques, which is likely to result in pain and distress for the pigs involved (Mcglone et al., 2004).

Paddles are another tool that may be used to move pigs. The idea of these is to pat the pig lightly with them so that the touch and sound that it creates catalyses the pigs to move (Mcglone et al., 2004). Although these are considered to be a more humane alternative to electric prods, this depends on how well trained the handler is, as they can still be used forcefully, causing pain to the animal (Wilhelmsson, 2022).

1 https://www.gov.uk/government/publications/pigs-on-farm-welfare

Furthermore, paddles result in similar levels of vocalisations as the electric prods, which, as vocalisations in pigs are commonly considered to be a sign of stress or anger, may mean that the paddles are as distressing, frustrating, or painful for the pigs as the electric prods (Mcglone et al., 2004).

Flags and boards are also used to move pigs and have fewer welfare considerations associated with them (Mcglone et al., 2004).

1.1.2 SHIPPING OR PICK-UP PENS

Prior to being loaded onto the truck, pigs may be placed into holding pens. These have some welfare advantages, as they allow the pigs to rest if they have travelled a long distance from their home pen. However, it is likely that pigs will be mixed with individuals from other pens at this point.

Mixing unfamiliar pigs is likely to result in increased levels of aggression, fighting, and injuries, as well as negative emotions, such as fear and distress (Faucitano, 2018; Goumon and Faucitano, 2017).

1.1.3 LOADING ONTO THE TRUCK

Loading ramps pose another welfare concern for pigs, and certain designs can cause stress and discomfort, and potential injuries. As slopes increase in degree from 0 to 45°, pigs show various physiological and psychological effects, including increases in heart rate, behavioural reactions such as turning back around and balking more frequently, and slipping and falling over more, resulting in more bruises and lesions (Dalla Costa et al., 2016; Garcia and McGlone, 2014; Goumon et al., 2013a; Goumon and Faucitano, 2017). Ramps inside the truck can also be problematic for pigs too and can be associated with more difficulties in handling, leading to greater use of electric prods (Ritter et al., 2008; Weschenfelder et al., 2012). Pigs also suffer elevated cortisol levels when exposed to internal ramps, compared with alternatives, such as hydraulic lifts (Weschenfelder et al., 2012). Ramps are considered to cause, or at least contribute to, the experience of long-lasting stress effects, and greater proportions of dead and fatigued pigs on arrival (Correa et al., 2014, 2013; Kephart et al., 2010; Weschenfelder et al., 2012).

1.2 WELFARE ISSUES ASSOCIATED WITH THE JOURNEY FOR PIGS

The welfare of the pigs during a journey is influenced by several inter-related factors, including temperatures, space allowances, numbers of pigs, and journey length. These factors are related to one another, and can be exacerbated or reduced depending on other variables (e.g. temperature is affected by stocking densities, and most factors are affected by journey length).

1.2.1 JOURNEY LENGTH AND DURATION

From the pigs' perspective, it is the duration of time that they are on the truck that is most important, as they may be required to wait for long periods during loading and unloading, and are subject to potential journey delays.

Currently (June 2022) the UK government states that the new Kept Animals Bill will introduce shorter maximum journey times for live animals to between four and 24hrs, depending on the species[2]. Journey length has a complex relationship with pig welfare, as some welfare concerns are exacerbated in shorter journeys, whereas others increase with journey length. Nevertheless, there are considerable welfare effects relevant to all journey lengths (Garcia et al., 2015). For example, in an extensive study of pig transportation which included over 2.7 million pigs during over 16,000 trailer journeys, increases in journey time from 30 mins to 4 hrs significantly increased the percentage of pigs who were dead on arrival, unable to walk, or were injured on the trailer (Sutherland et al., 2009). These findings show that journeys of less than 4 hrs, which are not typically considered to be 'long', can still have considerable negative impacts on pig welfare. In fact, journeys less than 3 hrs are thought to add additional impacts as they do not give the pigs time to lie down and rest, resulting in them being more fatigued at unloading, as they have not recovered from the exertion from loading (Kephart et al., 2010).

Many studies have also reported a negative effect of increasing journey length. For example, Voslarova et al. (2017) found a linear relationship between journey length and transport stress, resulting in pig deaths in their study on pig transportation. In another study, increasing journey length was also found to result in increased blood levels of creatine kinase, which is a physiological response to muscle exertion and damage, and was considered to be evidence of increasing physical fatigue in the pigs being transported (Sommavilla et al., 2017). In summary, both short and long journeys can have negative impacts on pig welfare, and the factors discussed in the following sections can exacerbate these issues further.

1.2.2 TRAILER MICROCLIMATE

Pigs are homeothermic animals, so it is important for heat production and heat loss to be well balanced to avoid causing undue stress (Bracke et al., 2020). Pigs have far fewer sweat glands, compared with other mammals, and therefore are less able to lose heat through sweating. Pigs rely on behavioural adaptations to thermoregulate themselves and will pant, seek shade, lie down on cool surfaces, avoid contact with other pigs, and wallow in mud to cool themselves down (Bracke et al., 2020). Most of these behaviours are unavailable to them during transportation, and this means that pigs are particularly vulnerable to heat stress (Bracke et al., 2020). Humidity is also relevant

2 https://www.gov.uk/government/news/better-welfare-conditions-for-millions-of-farm-animals-during-transit

to pig welfare, as high humidity levels in the truck will aggravate the heat stress the pigs are experiencing, as it reduces their ability to use evaporative cooling, such as panting (Bracke et al., 2020).

The microclimate inside the truck has significant implications for the welfare of pigs during any journey and can have fatal consequences (Faucitano, 2018). In the extensive study mentioned earlier, by Sutherland et al. (2009), they found that ambient temperatures of over 20°C resulted in significantly more pigs being dead on arrival, compared with lower temperatures. In particular, the highest number of deaths occurred when the temperature was over 25°C, whereas temperatures of 5°C and below resulted in significantly more pigs being unable to walk. In another study that observed over 41,000 pigs being transported, they found that temperatures of 17°C and over resulted in significantly more pigs performing open-mouth breathing, and showing skin discolouration (Kephart et al., 2010). Similar findings have been found in other studies. For example, Ritter et al. (Ritter et al., 2008) also found that pigs being transported during the spring or summer in the USA were more likely to perform open-mouth breathing and show skin discolouration.

Because of the negative impacts of temperature on pigs, there have been some improvements in the management of internal truck temperatures on hot days, however, some report that there is still more to be done to protect pigs against cold temperatures (Voslarova et al., 2017). Transporting pigs in cold temperatures can cause cold stress and effects include greater physical exhaustion and fatigue (Correa et al., 2014). Pigs have better adaptations for coping with colder temperatures, such as behaviours including huddling, but piglets are prone to cold stress when transported, and will quickly suffer from fatigue and require longer to recover and rest, indicating impaired welfare (Marchant-Forde and Marchant-Forde, 2008). If cold temperatures are not appropriately managed, however, numbers of pigs dying during transportation will increase at temperatures below 5°C (McGlone et al., 2014).

The effects of temperature upon pigs during transportation are aggravated by several factors. First, food deprivation affects pigs' abilities to cope with high and low temperatures on journeys. When deprived of food, there is little or no energy available for thermal regulation, and this results in both cold and heat stress occurring more rapidly and more severely than if the pigs were not starved (Bracke et al., 2020). Furthermore, the pigs' glycogen reserves are likely to be depleted from the exertion of loading, and so they have to burn fat in order to thermoregulate (Bracke et al., 2020). Second, the vibration and motion that the pigs are exposed to during transportation also require them to maintain their balance, and this additional muscle use is also likely to produce heat, which would further aggravate heat stress, and further the impact of food deprivation (Bracke et al., 2020). Third, because pigs are typically transported in crowded conditions, they cannot avoid contact with other pigs or lay on the floor to cool themselves, and this can increase relative humidity and reduce the air quality at their level (Bracke et al., 2020). In addition, this may mean they cannot access water if it is provided. Therefore, crowding can also negatively impact heat stress, aggravating and escalating its development (Bracke et al., 2020). Fourth, transported pigs may be at risk of draughts of air that are too cold or too hot for them. As these only hit parts of the pigs' bodies, and are location-dependent, they do not activate proper thermoregulatory responses and can cause some pigs to be too cold, and others too hot. Fifth, the length of the journey plays an important role, as the effects are more detrimental in longer journeys (Bracke et al., 2020). And finally, the type of pig and their condition can also impact their ability to cope with thermal stress. For example, larger animals are more prone to heat stress, and cull animals may be unfit or too thin or fat to thermoregulate effectively (Bracke et al., 2020).

1.2.3 NUMBER OF PIGS AND SPACE ALLOWANCES

The effects of pig number and the space allowances within a truck for each individual are directly impacted by the ambient temperature. When cold, pigs will huddle together to stay warm, too few pigs will increase the risk of cold stress, but this huddling behaviour also reduces

space availability and can lead to fighting and individuals climbing over the backs of others to find space to rest, resulting in more deaths (Voslarova et al., 2017).

In warm conditions, too many pigs can increase the ambient temperature further, and limit the ability of pigs to reach water, resulting in dehydrated pigs (Bracke et al., 2020). Too much space in a trailer can also be problematic for stability, as the pigs are likely to fall over more, resulting in more injuries and potential deaths (Garcia et al., 2015). This makes transporting pigs during hot weather particularly challenging, as higher numbers are needed to ensure stability, but this is also likely to result in heat stress and other welfare issues (Bracke et al., 2020).

1.2.4 DRIVING STYLE

Although drivers of farmed animals are generally required to be trained and competent, the driving style that drivers may adopt can still impact the well-being of the pigs being transported (Driessen et al., 2013). Pigs show physiological stress responses to different driving styles, including an increase in heart rate variability when drivers go too fast around corners (Peeters et al., 2008). Acceleration and heavy braking tend to reduce lying behaviour, limiting the pigs' ability to rest, and can cause instability and injuries, as well as fear in the pigs (Driessen et al., 2013). The condition and type of the truck also play a role, as well as the condition of the road surface (Driessen et al., 2013).

1.3 WELFARE ISSUES ASSOCIATED WITH THE UNLOADING OF PIGS

Although unloading is not considered to be as stressful as loading, there are still welfare concerns associated with the various stages and processes involved (Driessen et al., 2013). Pigs are still subject to panic, stress, and fear during unloading, especially if the process is not properly managed, resulting in individuals backing up and jamming the exits (Driessen et al., 2013). Many of the issues discussed in the loading section (1.1) are relevant here too, particularly how the pigs are moved, and the ramps they have to negotiate. Pigs subjected to stress at this point, such as from the use of electric prods, also become less easy to handle and struggle to adapt to lairage (holding pen used to rest the animals prior to slaughter) (Driessen et al., 2013).

1.3.1 ARRIVAL AND WAITING TIME AT THE DESTINATION

Once the pigs have arrived at their final destination, they may not be unloaded immediately, and the waiting time can have a significant impact on pig welfare (Faucitano, 2018). Increased waiting can cause an increase in heat and humidity in the stationary truck, which can influence the number of pigs who are injured, unable to walk, or are dead on arrival.

For example, Sutherland et al. (2009) found that the percentage of pigs who were dead on arrival was significantly greater at waiting times of 2, 3, and 4+ hrs, compared with at shorter waiting times.

1.4 OVERARCHING WELFARE ISSUES DURING TRANSPORTATION

The following welfare issues are relevant at various stages of the transportation process and can impact the welfare of the pigs being transported.

1.4.1 FEED AND WATER WITHDRAWAL

Feed withdrawal is a common practice for pigs who are transported to reduce mortalities, travel sickness, and for production reasons (Faucitano, 2018).

When starved, pigs become fatigued more readily, and experience frustration and distress, which can impact all parts of the process, but in particular, can make the pigs more resistant to handling and moving, resulting in increased stress (Faucitano, 2018). Furthermore, fasted pigs tend to show more fearful responses, compared with non-fasted pigs during loading and unloading (Acevedo-Giraldo et al., 2020).

Once pigs have reached the abattoir, they are often rested before they are slaughtered, and can be kept in lairage for a further 12 hours without being fed.

1.4.2 SOUNDS

Pigs have very sensitive hearing, and environmental noises can become aversive to them (Goumon and Faucitano, 2017). In particular, pigs find loud, uniform sounds mildly aversive, and loud intermittent sounds strongly aversive (Talling et al., 1998). When sound levels reach 70dB and higher, pigs become fearful and unwilling to move, and have higher heart rates and elevated cortisol levels, compared to at lower sound levels (Kanitz et al., 2005; Lippmann et al., 1999; Talling et al., 1996). All phases of the transportation process may be associated with loud and unpredictable noises. For example, sound levels during loading can range between 70-95dB (Taling et al., 1998; Vermeulen et al., 2016). Furthermore, gates clanging, and pig vocalisations can reach 80-103 dB, and cause fear behaviours and physiological responses in pigs (Kanitz et al., 2005; Talling et al., 1996).

1.5 THE LONG-TERM EFFECTS OF TRANSPORTATION FOR PIGS

Most pigs in the UK who are transported are done so for slaughter, and so the long-term effects of transportation are not relevant and are understudied for pigs. It is widely known, however, that such physiological and psychological effects can have long-term effects on animals, and so if pigs were being transported for other purposes, then there could be important, negative long-term impacts on their welfare to consider (Schwartzkopf-Genswein et al., 2012).

1.6 EMOTIONAL, FEELING PIGS

It is important to remember that these animals undergoing these experiences are sentient beings, which means that they can feel and experience a range of emotions and states, including both positive and negative ones (Marino and Colvin, 2015; Proctor, 2012). Pigs, like any sentient beings, want to feel good. They want to engage in positive experiences and feel positive emotions, such as joy and pleasure (Proctor, 2012; Proctor et al., 2013). Pigs are very intelligent, inquisitive, and playful animals. They actively seek opportunities to play and to do things they enjoy, such as wallowing, chasing, and rooting (Marino and Colvin, 2015). Unconfined pigs are very creative in their play. They like to play with both objects and other pigs and will chase, run, jump and flop on the ground, and wave their heads in play (Horback, 2014). Pigs are very clever too, and competitive. In one experiment where pigs foraged for food in pairs, only one pig was shown the location of the food, and so the uninformed pig followed the informed pig and got to the food first (Held et al., 2000). The informed pig soon caught on though, and changed their behaviour in later trials, so that they could keep the upper hand.

Although they are considered domesticated, most farmed pigs are still nervous of humans and have little interaction with them. This means that the close presence of humans during transportation, along with the many other stressors involved, can induce fear and stress in the pigs. Pigs are experts at communicating their emotions to other pigs, and as a result, their emotional states will also spread through a group in a process known as emotional contagion (Goumon and Špinka, 2016; Reimert et al., 2017). This means that if one pig is hurt or stressed, then the rest of the group will feel stressed, negative, and fearful, too. Pigs who watch others experience something painful also react more aversively to the experience themselves, than if they had not been a witness first (Goumon and Špinka, 2016). This has important implications for the whole process of transport, as if a pig sees another pig receive an electric prod, for example, they may become fearful and stressed as they anticipate the experience themselves. Unfortunately, as soon as pigs become stressed, they also become more difficult to handle, and this commonly results in more forceful handling measures and the use of electric prods (Driessen et al., 2013). Using such techniques results in distress, fear, and pain in these sensitive and emotional beings.

1.7 CONCLUSION

The transportation process for pigs is highly stressful, as evidenced by the many physiological and psychological effects on their welfare discussed above. There are many ways in which the process can be worsened or improved for pigs, but all forms of transportation incur some degree of stress and fear for pigs as they are not habituated to the process, are required to enter new situations, and experience unfamiliar sensations and practices. Given that these are sentient beings, their feelings and experiences are important and matter to them and to us.

2 CATTLE AND CALVES

There are important breed and age differences to consider for cattle in transportation, as the condition of a cull dairy cow may be significantly less robust than a finished beef cow. Whereas, young calves of any breed are especially vulnerable to welfare issues during transportation. The following sections discuss the welfare impacts of transporting cattle, and where additional factors are relevant, specific references to dairy cows, beef cattle, or calves are made.

2.1 WELFARE ISSUES ASSOCIATED WITH THE LOADING OF CATTLE

For cattle, the loading and unloading phases of transportation are often more stressful than the journey itself, yet these processes often have fewer regulations regarding the time they can take, or the conditions required for good welfare (Losada-Espinosa et al., 2018).

2.1.1 MOVING CATTLE

How an individual reacts to handling depends on many factors and can vary widely. Intensively reared beef cattle are likely to be less familiarised with humans and may find the close presence of humans during loading stressful. Differences in individual personality type, previous handling experiences, and age also play an important role (Grandin and Shivley, 2015). The novelty of the loading processes is also likely to be stressful for cattle, and some individuals may be more fearful than others. The attitudes and training of the stock people involved in moving the cattle can also have a significant impact on the experience of the cattle during loading and can influence the likelihood of aversive goads and tools being used (Losada-Espinosa et al., 2018).

Electric prods are very stressful and painful for cattle, and their use is limited in UK legislation but is permitted for cattle over 6 months[3] (Losada-Espinosa et al., 2018; Whiting, 2016). Cattle show a range of behavioural reactions to the electric prod, including balking, vocalising, stumbling, falling, and running, which are demonstrative of their aversive experience (Simon et al., 2016). Poor handling of cattle, including shouting, hitting, slapping, and use of electric prods is also known to increase the flight distance of cattle from humans, which can be long term, and indicates fear (Breuer et al., 2000).

3 https://www.legislation.gov.uk/uksi/1997/1480/made

The physical exertion of moving cattle during loading also has physiological and emotional effects. One study found that heart rate was the highest in cattle during loading and unloading, and concluded that this physiological effect showed the experience to be highly stressful for cattle (Gebresenbet et al., 2012).

2.1.1.1 CALVES

Calves are easily stressed during loading, as their young age exacerbates stressful responses to novel experiences (Gebresenbet et al., 2012). In particular, although all cows, calves, and bulls were shown in one study to have elevated heart rates during loading and unloading, compared with at rest, calves showed the greatest increase overall (Gebresenbet et al., 2012).

Most of the experiences of transportation are completely new to calves, and so they often show hesitance in using ramps and entering trailers, as they represent entirely novel experiences (Gebresenbet et al., 2012).

2.2 WELFARE ISSUES ASSOCIATED WITH THE JOURNEY FOR CATTLE

There are several inter-related issues that can worsen or improve the cattle's experience of the journey itself. Cattle are legally required to be fit for transportation, which means that they need to be healthy and robust enough to withstand the journey (unless going to a veterinarian), and in the UK, calves must be at least 7 days of age[4]. Transportation can still be highly stressful and result in significant welfare issues for cattle who are fit and healthy though (Jongman and Butler, 2014; Schwartzkopf-Genswein et al., 2012). However, the effects of transportation on fragile cattle, such as cull cows and young calves, are likely to be even more considerable, although this area has been understudied (Schwartzkopf-Genswein et al., 2016).

2.2.1 JOURNEY LENGTH AND DURATION

From the perspective of the animals, it is the duration of time that they are on the truck that is most important, as they may be required to wait for long periods during loading and unloading and are potentially subject to journey delays (Schwartzkopf-Genswein et al., 2016). The duration of the journey can have varying impacts on the well-being of cattle and calves during transportation, and both short and long journeys can negatively impede their welfare. In particular, the distance, or duration of transportation is strongly affected by the provision, or withdrawal of feed and water, and the number of rest intervals, which may cause dehydration and energy depletion (Schwartzkopf-Genswein et al., 2012) (also see section 2.4.1.).

Several studies have found that the longer cattle and calves are transported, the greater the number of dead and injured animals there are on arrival, and the greater risk of post-transportation mortality for those not going to slaughter (Schwartzkopf-Genswein et al., 2016). For example, in one study that explored the welfare impacts of journeys of 400 km and above, they found that the number of animals who were dead, lame, or unable to walk or stand significantly increased along with the time spent on the truck (González et al., 2012a). In particular, they noticed a marked increase in issues when cattle were on the truck for over 30 hours. They also explored the effects of other factors, including temperature, animal density, and the experience of the truck drivers, which are discussed in the following sections.

4 https://www.legislation.gov.uk/uksi/2006/3260/contents/made

Both long and short journeys or transportation times can negatively impact cattle's wellbeing. For instance, one study which assessed the responses of bulls, cows, and calves to different transportation times found short journeys were actually associated with the highest concentrations of cortisol (stress hormone), suggesting that even short journeys, which are often considered to be better in terms of welfare, also have negative impacts on the animals, as cattle find them particularly stressful (Gebresenbet et al., 2012). In fact, the cows and calves showed the greatest concentrations of cortisol in response to journeys under two hours. All the animals; bulls, calves, and cows, showed increased cortisol levels in all journey lengths compared with before transportation though, so the study showed that no matter what the length of the journey was, the cattle and calves found it to be a stressful experience (Gebresenbet et al., 2012). Gebresenbet et al. also found that glucose, creatine kinase, and lactate concentrations increased with transport time for the bulls, cows, and calves, particularly after 6 hours of journey time. Elevated levels of each of these physiological parameters are associated with stress (Gebresenbet et al., 2012).

2.2.1.1 CALVES

Calves under 3 months of age are not adapted to cope with the stress of transport, as their immune system and stress responses are not yet fully developed (Damtew et al., 2018; Roadknight et al., 2021). This can result in long-term effects on the health and welfare of calves (see section 2.5.) (Goetz et al., 2022). In one study, 28-day-old calves showed improved immunity responses and antibody concentrations following transportation, compared with 14-day-old calves. Neither group of calves had fully developed immunity, but their findings showed that the younger the calves are during transportation, the less immunity and adaptivity they have to potential diseases (Marcato et al., 2022b). Calves who are transported at 14 days are also more likely to lose weight and require medicine after transportation, compared with 28-day-old calves (Marcato et al., 2022a). Fourteen-day-old calves also had a higher risk of mortality during transportation, compared to 28-day-old calves. Young calves show a range of physiological responses to transportation that indicate both physical and emotional stress, including increased body temperatures, heart rate, and cortisol and adrenaline levels (Bravo et al., 2018; Odore et al., 2004).

2.2.1.2 REST STOPS

The effects of rest stops on the welfare impacts of transportation are understudied. In one of the few studies in this area, calves who were given rest stops still experienced the same level of poor welfare as the calves who had not

been given rest stops (Meléndez et al., 2020). In particular, rest stops had no positive effect on indicators of fatigue, dehydration, stress, or immune status in the calves. Furthermore, calves who were subjected to 36 hrs of transportation experienced poorer welfare, compared with those who were transported for 12 hours, and the effects lasted for at least 14 days following transport. The effects included increased lying time, decreased weight gain, decreased body weight, and increased dry matter intake (Meléndez et al., 2020).

2.2.2 TRAILER MICROCLIMATE

Cattle are homeothermic, and so although they are adapted to changes in temperature, extreme changes can place significant stress on their bodies, particularly when they cannot perform adaptive behaviours (Schwartzkopf-Genswein et al., 2012). The microclimate of the trailer, which is the combination of temperature, relative humidity, and temperature-humidity index, is affected by several factors. These include the ambient temperature, loading density, airflow, and animal factors, such as respiration, sweat, and excretions, which can all increase or decrease the heat or moisture in the trailer (Schwartzkopf-Genswein et al., 2012). The microclimate within the trailer may also vary according to the position, compartment, motion of the truck, and ventilation (Schwartzkopf-Genswein et al., 2012). The microclimate can be one of the largest threats to animal welfare during transportation (Mitchell and Kettlewell, 2008).

Studies have found different effects from ambient temperatures, and these can have lasting effects on cattle welfare (Schuetze et al., 2017). One study found the highest mortality rates at low ambient temperatures of -15°C, which they suggest is because of the lower temperature exacerbating the effects of feed withdrawal and physical activity (González et al., 2012a). Mortalities also increased sharply when the temperature was above 30°C, as did the number of individuals who could not walk or stand (González et al., 2012a).

2.2.2.1 CULL DAIRY COWS

Cull dairy cows are susceptible to thermal discomfort if they are exposed to environments that are colder than those they are acclimatised to, and their exposed udders are susceptible to frostbite (Cockram, 2020). The poor body condition of cull dairy cows also predisposes them to thermal discomfort in colder temperatures, because of reduced tissue insulation (Cockram, 2020).

2.2.3 NUMBER OF CATTLE AND SPACE ALLOWANCES

Both too much, or too little space during cattle transportation can compromise animal welfare, and so typically, legislation depicts the loading density that is considered to be optimal, based on economic and animal welfare factors (Schwartzkopf-Genswein et al., 2012). Studies have found that cattle who are transported in very low densities, and very high densities, are significantly more likely to die, be lame, or be unable to stand or walk following transportation (González et al., 2012a). Too low a density can cause the cattle to become unstable and fall, whereas too high a density can affect the microclimate, increase the chance of individuals becoming trapped, and impede the ability of cattle to breathe properly and dissipate heat (González et al., 2012a; Schwartzkopf-Genswein et al., 2012). Cattle also require recumbent rest, especially when

deprived of feed, but they rarely lie down during transportation (Nielsen et al., 2011). This lack of rest can have an accumulative effect, resulting in fatigue. There are also long-term effects of loading density on cattle welfare, such as the likelihood of contracting diseases. These are discussed in section 2.5.

2.2.4 DRIVING STYLE AND EXPERIENCE

The amount of experience a driver has in transporting cattle also plays a role in their welfare. González et al. (2012) found that drivers who had over 10 years of experience had fewer incidences of welfare-compromised cattle compared with those who had been driving for less than 10 years. It is likely that the more experienced drivers had a better understanding of regulations and best practices, but are also likely to have a smoother driving style (González et al., 2012a). Driving style is known to behaviourally and physiologically affect cattle. When driven in a 'stop-start' driving style, cattle were described as being restless, agitated, and scared (Stockman et al., 2013). Whereas cattle driven in a smooth driving style were described as being calm, relaxed, and comfortable. These behavioural assessments were also supported by physiological measures of stress, which indicated that the cattle being driven in the stop-start style were more stressed than those who were driven smoothly (Stockman et al., 2013). Cattle suffer particularly during braking and will always endeavour to brace themselves in a vehicle to minimise the risk of being thrown around, and contacting others (Gebresenbet et al., 2011).

2.2.5 CATTLE CONDITION

The effects of transportation vary significantly depending on the condition of the cattle being transported. For example, mature or fat cattle who are transported for slaughter have fewer welfare issues compared with calves, feeders,[5] and cattle who are to be culled (González et al., 2012b). Calves are also more likely to become unable to walk or stand, or to die, compared with fat and feeder cattle, because of their underdeveloped immune system and poorer body condition (González et al., 2012a).

2.2.5.1 CULL DAIRY COWS

There is little research on the factors that are likely to impact the welfare of cull dairy cows during transportation, despite its importance (Cockram, 2021).

Dairy cows may be culled for several reasons, including reduced productivity, lameness, and disease. The welfare issues associated with transportation are more considerable for weak, diseased, and injured cows, as they are already experiencing pain and weakness, and are less able to cope with the additional challenges of transportation (Cockram, 2020, 2019). As a result, cull cows who are sent for slaughter with pre-existing conditions, are more likely to die in transit, become debilitated and unable to stand or walk, or require euthanasia upon arrival, than those who are healthy (Cockram, 2019). For example, a study in the Czech Republic recorded a higher mortality rate for cull dairy cows during and shortly after transportation, compared with fattened cattle (Malena et al., 2007). The mortality rates were also worse for longer journeys, compared with shorter ones. In the UK, animals must be fit for transport, unless being transported to a veterinarian. It is likely, though, that some unfit cattle are still transported, whether or not their conditions are visible at the farm (Cockram, 2020).

Lameness is a significant welfare issue in dairy cows (Cockram, 2020). Although lameness can generally be detected reliably, there is often a discrepancy between identifying lameness and assessing whether the cows are fit for transport (Dahl-Pedersen et al., 2018). Obviously lame cows are sometimes still selected for transportation by farmers who deem them to be only mildly lame or claim to not recognise the signs (Dahl-Pedersen et al., 2018). Lameness is a major welfare concern during transportation, as lameness is painful, and cows are more reluctant to bear weight on affected legs. As a result, they will be more unstable during transportation, and more likely to lie down, increasing the risk of other cows falling over onto them. Furthermore, the additional walking and standing required during the transportation is likely to aggravate the lameness (Cockram, 2020).

5 Feeder cattle are young, lean cattle who are mature enough to be fattened for slaughter.

Some cull dairy cows may be in early lactation when transported (Cockram, 2020). If a lactating cow is not milked at regular intervals, milk will accumulate in the udder, causing increasing intramammary pressure, which can cause tissue damage, discomfort, and pain, further reducing their welfare (Cockram, 2020).

Cull dairy cows are also more susceptible to bruising, compared with fattened cattle, indicating compromised welfare partly from handling and partly from the journey itself (Strappini et al., 2013, 2010). Trailer design can also play a role, as Holstein cows are quite tall, and hit their hips, backs, and heads on the trailer (Lambooij et al., 2012). Cull dairy cows typically have a low body condition score too, especially if they are high-producing dairy cows, as they cannot consume enough energy to meet the energy demands of lactation (Cockram, 2020). This has an accumulative effect from each lactation cycle, and by the time the cow is culled from the herd, she may have a low body condition score, appearing thin and emaciated (Cockram, 2020). Thinness in cows is thought to increase discomfort in cold environments, and increase the likelihood of injuries, bruising, and being unable to walk or stand (Cockram, 2020).

2.3 WELFARE ISSUES ASSOCIATED WITH THE UNLOADING OF CATTLE AND CALVES

Depending on the journey length, and their experience during transportation, the unloading of cattle can be stressful for cattle and calves, especially if they have been injured or suffered during the journey. Heart rates in cattle are higher during unloading, compared with before transportation, and during the journey itself, indicating that cattle find unloading to be very stressful (Gebresenbet et al., 2012).

2.3.1 MOVING CATTLE

Like with loading, the methods used to handle and move the cattle can have a considerable effect. Cattle take longer to unload when aversive methods such as cattle prods and sticks are used, compared with just using flags (Huertas et al., 2018). How close the driver has parked to the unloading ramp can also impair welfare during unloading, as a gap of over 5cm may cause injuries (Huertas et al., 2018).

2.3.2 ARRIVAL AND WAITING TIME AT THE DESTINATION

Unloading delay is another factor that can add to the duration of the journey and exacerbate any welfare issues incurred. If lairage facilities are unavailable, or if trucks arrive too late, then cattle may have to stay on the truck for longer than is necessary (Schwartzkopf-Genswein et al., 2012).

2.3.3 CALVES

Calves find unloading to be stressful, and their behaviour is often indicative of fear and distress. For example, calves may slip over and vocalise during unloading, especially when the stock people use negative tactile interactions, such as hitting, to move them (Bravo et al., 2020).

2.4 OVERARCHING WELFARE ISSUES DURING TRANSPORTATION OF CATTLE AND CALVES

2.4.1 FEED AND WATER WITHDRAWAL

Cattle and calves may be deprived of feed prior to their journey, as well as for the journey itself, depending on their destination, and other factors such as rest breaks, and journey length. Feed and water deprivation can exacerbate many of the welfare issues incurred from transportation, as well as introduce new issues. For example, fasting in adult cattle can cause significant body weight loss, increasing along with the duration of fasting (Schwartzkopf-Genswein et al., 2016). Weight loss results from both water and tissue loss, and long journeys are more likely to result in muscle tissue loss (Schwartzkopf-Genswein et al., 2016). Fasted cattle also show physiological signs of dehydration during transportation, including increased red blood cell count, total protein levels, and haemoglobin levels (Schwartzkopf-Genswein et al., 2016). Fasting can quickly result in hunger, weakness, increased susceptibility to the cold, and ketosis (fat burning process). These effects can be significant for young cattle, and those with poor body conditions, such as cull dairy cows (Cockram, 2021).

2.4.1.1 CULL DAIRY COWS

Cull dairy cows are not typically fed or watered on journeys and are likely to have feed withheld during the pre-slaughter period (Cockram, 2021). This can result in the cows having to use their body energy reserves and proteins, and this can be particularly significant for lactating cows. In fact, lactating cows can show metabolic changes within 24 hrs of fasting and will rely heavily upon their fat reserves when fasting. This is problematic for individuals who are already thin, as they will have little reserves left, and are likely to suffer considerably, both physiologically and psychologically (Cockram, 2021). As a result, lactating cows are more likely to become non-ambulatory (unable to stand or walk) when transported without feed (Cockram, 2021).

2.4.1.2 CALVES

Feed and water deprivation in calves is also a considerable welfare issue during transportation, as like cull dairy cows, they do not have the energy reserves to rely upon and are not as robust as a healthy adult cow (Fisher et al., 2014).

One study found that feed withdrawal in transported calves resulted in a loss of 6% of their body weight, more lying time during transportation, and negative changes in their blood biochemistry and metabolism, compared with untransported calves (Fisher et al., 2014). Whereas weaned beef calves have been shown to lose an average of 10kg each after 24 hrs of fasting (feed and water) and short transportation (Bravo et al., 2018). The calves also showed several significant physiological indications of stress, fatigue, and dehydration (Bravo et al., 2018).

2.5 THE LONG-TERM EFFECTS OF TRANSPORTATION FOR CATTLE AND CALVES

Not all cattle are transported for slaughter, some are transported several times throughout their lifetime. For beef production, each of the three phases, calf rearing, growing, and fattening, often take place in separate specialised farms. Therefore, the long-term implications of transportation are important for cattle. The stress experienced during transportation can have lasting effects on cattle and calves, particularly on their immunity and health.

2.5.1 CALVES

Calves are more likely to develop bovine respiratory disease (BRD) after being transported, because of the immunosuppressant effect of the stress they incur (Damtew et al., 2018; Earley et al., 2017). BRD is a significant welfare concern, as it often leads to other diseases, and is associated with mortality rates of between 35 – 55% (Damtew et al., 2018). Shipping fever, pneumonia, and diarrhoea are also common post-transport issues for calves (Damtew et al., 2018). Dairy calves who have been transported are also more likely to show physiological indicators of inflammation following transportation (Goetz et al., 2022). They are also more likely to have lost weight and show a suppressed average daily weight gain for up to 28 days after transport (Goetz et al., 2022). The long-term effects on health can be influenced by the number of cattle or calves who are loaded onto a trailer. For example, in one study, calves who were transported in compartments of 16 – 30 calves were more likely to be treated for sickness, compared to groups of 15 or less (White et al., 2009).

2.5.2 ADULT CATTLE

In adult cattle, the stress experienced can also cause failures in reproduction. Stress can retard the development of reproductive organs in cows, increase embryo and foetal loss, and cause fertility issues, diminishing their reproductive success (Damtew et al., 2018). Although this is more of a production cost, the cost to the cow is that she will probably be culled sooner if she cannot reproduce.

2.6 EMOTIONAL, FEELING CATTLE

Cattle are highly emotional, social, and complex animals (Marino and Allen, 2017). They are sentient beings, which means that they can experience positive and negative emotions, become fearful and stressed, and enjoy activities that make them feel good (Lambert and Carder, 2019).

Cattle are capable of a wide range of emotional states, but because they are prey animals, it may not always be clear when they are feeling stressed or fearful (Weary et al., 2006). Therefore, studies often rely on physiological measures such as heart rate and cortisol levels. Nevertheless, cattle communicate their emotions in several visible ways, including their eye whites, tail and ear postures, behavioural responses, and vocalisations (de Oliveira and Keeling, 2018; Lambert and Carder, 2019, 2016; Proctor and Carder, 2016). Cattle also show aversive behavioural reactions when being transported, which indicate their experience of fear. These may include reluctance to move, backing up, escape attempts, and vocalisations (Simon et al., 2016). Cattle are all individuals, with their own personalities and temperaments. Their personality traits can impact their well-being during transportation too, as they may be

more or less able to cope with the stressors, and temperamental individuals are more susceptible to diseases, because of the effect of stress on their immune system (Burdick et al., 2011).

The stressful, and sometimes painful experience of transportation may also have long-term effects on the emotional well-being of cattle. Calves, for example, are more pessimistic following painful disbudding procedures (Neave et al., 2013), and after being separated from their mothers (Daros et al., 2014). Cattle can also experience emotional contagion, which is the spread of emotional state throughout the group and is thought to be a simple form of empathy (Marino and Allen, 2017). Cows who are partnered with fearful cows, for example, are more likely to feel stressed and fearful themselves (Boissy et al., 1998). This can have important implications for transportation, as stressed or fearful individuals can spread their negative emotional state to others in the group.

Cows are also intelligent beings, and studies have shown that they enjoy learning and express pleasure in learning a new task. This is referred to as the 'eureka moment' (Hagen and Broom, 2004). Cows also get pleasure from being stroked or brushed by a familiar person and will even pursue a retreated stroker to elicit more stroking (Bertenshaw and Rowlinson, 2008; Proctor and Carder, 2014; Westerath et al., 2014). Stroking can also calm cattle and reduces their stress levels during stressful experiences (Waiblinger et al., 2004). Whereas aversive handling, such as the use of electric prods and hitting, results in stressed and fearful cattle (Losada-Espinosa et al., 2018), and these effects can quickly spread through the herd (Marino and Allen, 2017).

2.7 CONCLUSION

Transportation is highly stressful for all cattle, but particularly for calves and cattle in poor body condition. There are many factors that can exacerbate or improve the experience of transportation, but in general, there are no positive aspects of transportation for cattle, and it is, therefore, an experience they would like to avoid if given the choice. The potential for significant injury and harm during transportation is considerable for all individuals, and cattle may be transported several times during their lifetime, further increasing the risk. Cattle are sentient beings, and so the likelihood of them feeling fear, stress, and potentially pain during transportation is a significant ethical concern.

3 CHICKENS

The welfare issues during transportation for chickens who have been bred for meat (broilers) and hens who are bred for egg-laying (layers) can differ for transportation, and so the following covers welfare issues for chickens and specific concerns related to broilers and layers where appropriate. Both layers and broilers are often only transported as chicks to the farm for rearing, and then one last time to the slaughterhouse. Broilers are much younger, although larger, at around 6 or 7 weeks of age, whereas end-of-lay hens are usually around 72 weeks old. Neither layers nor broilers are typically in a good state for transportation, because of the pressures that production and selective breeding have placed on them (Jacobs et al., 2017a; Vecerkova et al., 2019).

Unlike other farmed animals, chickens are loaded and unloaded in crates, and so the process and welfare implications are different for these parts of the process. The following section on loading focuses on the effects of catching and loading the chickens into their respective drawers or crates. There is no unloading section for chickens, as they are simply removed from the truck in their crates, and then either kept in lairage or taken directly for slaughter.

3.1 WELFARE ISSUES FOR CHICKENS ASSOCIATED WITH CATCHING AND LOADING FOR TRANSPORTATION

The catching and loading of chickens are often considered to be the most stressful parts of the transportation process, but it can also seriously worsen their experience throughout the rest of the transportation process, due to the likelihood of them incurring injuries and fractures (Schwartzkopf-Genswein et al., 2012). Chickens may be caught for transportation via automated machines or manually by a team of catchers. When performed manually, five or more birds are typically grasped by the leg, inverted, and carried by the catcher in each hand (Schwartzkopf-Genswein et al., 2012). In a mechanical catching system, the birds are pulled by rubber-fingered rotors onto a conveyor belt in the upright position (Schwartzkopf-Genswein et al., 2012). Both manual and automated processes have welfare concerns for the birds involved and are discussed for broilers and layers separately below.

3.1.1 BROILERS

In the UK many broilers are still caught manually, but mechanical catching is increasing. Mechanical catching is thought to lead to less stress and physical injuries in broilers, compared with manual catching (Benincasa et al., 2020). Although the findings are mixed, and some still report similar levels of fractures from mechanical and manual catching (Jacobs et al., 2017a).

3.1.1.1 STRESS

Catching is considered to be one of the most stressful situations in broilers' lives, with many suffering from bruising, scratching, fractures, and fatalities from both manual and automated processes (Queiroz et al., 2015; Schwartzkopf-Genswein et al., 2012). In fact, the catching process is considered to be more stressful than the journey itself (Benincasa et al., 2020), and cortisol levels can be at their highest right after catching and loading in broilers, compared with at other stages of transportation and slaughter (Schwartzkopf-Genswein et al., 2012).

3.1.1.2 FRACTURES AND INJURIES RESULTING FROM MANUAL VERSUS MECHANICAL SYSTEMS

In both manual and mechanical systems, catching and loading broilers significantly increases the prevalence of wing fractures, compared with baseline measures, and this is positively correlated with the time taken to catch and load the birds (Jacobs et al., 2017a).

When caught manually, birds are typically caught and held by their legs. In fact, this method is listed in DEFRA's Code of Practice for broiler chickens as an acceptable method if both legs are carried[6]. However, in one comparison of catching methods, leg carrying of multiple birds was found to result in longer loading time, more wing fractures, and increased crowdedness in the crates, compared with when one or two broilers were caught upright and carried under the abdomen (Kittelsen et al., 2018). Leg holds also result in significantly more leg bruising in broilers, compared with upright holds (dos Santos et al., 2020). The fact that the leg carrying method increased the overall time the birds spent in the crates prior

6 https://www.gov.uk/government/publications/poultry-on-farm-welfare

to transportation is important, as broilers find the crates particularly stressful, and become increasingly stressed when crated. In fact, the cortisol levels of crated birds can take over two hours to reduce to levels seen in birds who have been handled but not crated (Voslarova et al., 2011). And some studies report a 3-fold increase in broilers' cortisol levels after 4 hrs of being crated, suggesting that the experience is particularly distressing for the birds (Chloupek et al., 2008). The increase in fractures from leg carrying is also concerning, although both the leg carrying and upright methods resulted in wing fractures, and negatively impacted the welfare of the birds (Kittelsen et al., 2018). Fractures are considerably painful injuries, and significantly compromise their welfare (Benincasa et al., 2020). Their pain is then exacerbated through the following transportation and pre-slaughter processes.

Mechanical loading is increasingly being implemented to increase efficiency and improve animal welfare. Although various studies have reported mixed results in terms of welfare (Jacobs et al., 2017a; Mönch et al., 2020). In one study comparing manual and mechanical methods of catching and loading broilers, fewer broilers had wing haematomas (severe bruises) when manually loaded, compared with mechanically loaded birds (Mönch et al., 2020). The mechanical loading system also resulted in more broilers being dead on arrival, but there was no significant difference in this study on the number of severe wing injuries between systems (Mönch et al., 2020).

3.1.2 LAYING HENS

The nature of the catching process for layer hens depends on whether they are raised in cages, barns, or multi-tier aviaries. Like broilers, commercially reared laying hens are not accustomed to being handled, and the experience, even with gentle handling, can cause stress and fear in the hens (Gerpe et al., 2021). Typically, hens are caught by one or two legs and carried upside-down in groups of 3-5 (Gerpe et al., 2021). Catching hens by one leg results in significantly more fractures than when caught by two legs, but both methods cause unnecessary fractures and the experience of being inverted is considerably distressing for the birds (Gerpe et al., 2021).

3.1.2.1 STRESS AND FEAR

Layer hens find catching and loading to be very stressful, and show significantly increased concentrations of cortisol, compared with baseline measures (Gerpe et al., 2021). They also show changes in temperature, indicative of their bodies being in fight-or-flight mode, and increased respiration rates, compared with baseline (Gerpe et al., 2021). These measures show that hens are in a state of high alert and find the experience to be stressful. Hens also exhibit fearfulness during the process and are more likely to perform tonic immobility when it is experimentally induced, after being caught and loaded, compared with control hens. Tonic immobility is a fear-potentiated response to being restrained, and chickens who think they are going to die may go into this catatonic state. The finding that the caught and loaded hens were more likely to exhibit tonic immobility suggests that these birds were experiencing greater feelings of fear compared with the control hens (Gerpe et al., 2021).

3.1.2.2 FRACTURES AND INJURIES

In one study of the welfare impacts of catching free-ranging birds from multi-tiered aviary systems, over 8% of the birds were found to have skeletal injuries such as bone damage and dislocated joints because of catching and loading (Gerpe et al., 2021).

To minimise escapes, crates with a small opening at the top, or drawers, are typically used. Birds are susceptible to bruising when pushed through the small opening, or into the drawers (Benincasa et al., 2020). Furthermore, Gerpe et al. found that some catchers would drop the birds into the crate from the top, and some would push several hens into a crate at once. They also noted that when the last hen was placed into the crate, they often had to be squeezed in. As a result, Gerpe et al. suggested that most of the fractures seen in their study resulted from these crating activities. The hens were also found to have increased levels of plasma creatine kinase, compared with baseline levels, which indicates muscle injuries, caused by the birds being inverted by the legs, exhibiting excessive wing flapping, and colliding with the pen furniture (Gerpe et al., 2021).

Although catching is easier with caged hens, and they are less likely to collide with pen furniture, caged hens have weaker bones, compared with those in cage-free systems. This is because of the lack of opportunities for normal movement. This has historically led to higher rates of fractures, compared with free-range hens (Gerpe et al., 2021; Rodriguez-Navarro et al., 2018).

3.1.3 TRAINING AND ATTITUDE

The methods used to catch the birds have different welfare impacts, but the catcher's attitudes and training have a greater overall effect. For example, the longer the birds are suspended in the catcher's hands, the more likely they will become injured (Langkabel et al., 2015). Because of the unpleasant environment of the aviaries, which are high in dust and ammonia, workers tend to be young people with little experience, rather than seasoned workers (Pilecco et al., 2013).

Even when professional catchers are used, there is no significant reduction in fractures incurred, compared to when farmers use untrained acquaintances (Jacobs et al., 2017a).

3.2 WELFARE ISSUES ASSOCIATED WITH THE JOURNEY FOR CHICKENS

As with the species discussed above, the welfare considerations for chickens during the journey itself depend on several inter-related factors, which are discussed below. Furthermore, the experience of the birds during the catching and loading stage can significantly worsen their well-being during the journey, especially if they incur fractures, as these will cause extensive suffering and potentially fatalities on the journey.

3.2.1 JOURNEY LENGTH AND DURATION

The entire transportation time for an individual begins from the moment they are loaded onto the truck and lasts until they are unloaded. This may be longer for some individuals than others, for example, if they are loaded on first and then unloaded last, and this can exacerbate the welfare issues associated with journey duration (Nielsen et al., 2011). For instance, the longer the journey, the more likely an individual will die from a chronic disease that limits their coping abilities, an injury incurred during catching and loading, or from the ambient temperature, which may be exacerbated by feed and water withdrawal (Cockram and Dulal, 2018).

3.2.1.1 BROILERS

Journey length and temperature are commonly thought to be the most important factors affecting broiler welfare during transportation and are most likely to cause fatalities (Parker, 2018). In particular, several studies have found that long journeys of over 50km are associated with greater numbers of mortalities, compared to shorter journeys (Saraiva et al., 2020; Vecerek et al., 2016, 2006). One study found that mortality rates doubled between journeys of 90km, compared with 15km (dos Santos et al., 2020). Longer journey durations are also associated with increasing loss of body weight in broilers (Jacobs et al., 2017a). This is thought to be because the birds are often withdrawn from feed and water before, and during, transportation, and because they also defecate more during transportation, which is a sign of stress (Jacobs et al., 2017a). Plumage cleanliness also decreases with longer journeys, which can impede thermoregulation, especially in colder temperatures (Jacobs et al., 2017a). Increasing journey duration also exacerbates the effects of fasting and can negatively impact thermoregulation in the birds (Jacobs et al., 2017a).

3.2.1.2 LAYING HENS

End-of-lay hens suffer high levels of mortality during transportation, so welfare scientists often argue that they should not be transported (Nielsen et al., 2011). In one study, significantly more hens died during longer journeys of 50-300km, compared with on journeys of up to

50km (Vecerkova et al., 2019). There were significantly fewer deaths for journeys over 300km, but the data may have been skewed by the small sample size for those journeys, compared with the shorter ones. In another study, Weeks et al. (2012) found that the distance travelled was a highly significant predictor of death during transport in end-of-lay hens, although they suggest that this may be because of extraneous variables in those journeys. Finally, another study that looked at very long journeys of over 800km, found that the number of mortalities recorded was nearly three times those on journeys of 0-200km (Çavuşoğlu and Petek, 2021). The hens also suffered more weight loss as the journeys increased in length, which was considered to result from increased transport stress (Çavuşoğlu and Petek, 2021).

The microclimatic conditions in the trailer are one of the most significant sources of stress for chickens during transportation, and the greatest cause of deaths resulting from thermal stress (Benincasa et al., 2020). Both heat and cold stress are significant issues for birds (Schwartzkopf-Genswein et al., 2012).

3.2.2 TRAILER MICROCLIMATE

Birds respond to heat stress by panting, which generates heat and moisture within the vehicle, and soon becomes ineffective as a thermoregulatory mechanism when the air becomes saturated (Schwartzkopf-Genswein et al., 2012). When too cold, birds respond by huddling, placing their head and feet under their body, shivering, and vasoconstriction (Cockram and Dulal, 2018). Birds who cannot thermoregulate are likely to die unless the conditions improve (Schwartzkopf-Genswein et al., 2012).

The microclimate in the trailer is affected by many factors, such as whether it has climate-control systems in place or not, as manual ventilation, by opening shutters and vents, is only beneficial if the truck is moving (Cockram and Dulal, 2018). Other factors, including the number of birds on the vehicle, can have an important effect, as large numbers of birds produce a lot of metabolic heat and moisture (Cockram and Dulal, 2018). The position inside the truck can also have a significant impact on the microclimate, because of various factors such as ventilation, stocking density, height in the truck, and the configuration of drawers or modules (Weeks et al., 2012).

The external temperature can have a considerable effect on the trailer microclimate and the welfare of the birds, and external temperatures of over 18°C can cause a steep increase in birds who are dead on arrival (Cockram and Dulal, 2018). Colder external temperatures also have an impact, and often the numbers of birds who are dead on arrival are higher during winter months (Cockram and Dulal, 2018). This may be because drivers cover the sides of the truck in cold and wet weather, which may be beneficial for protecting the birds against cold stress, but it can also result in pockets of raised temperature and moisture in some parts of the truck where birds are crowded, and there is insufficient ventilation (Cockram and Dulal, 2018). Birds may die from heat stress as a result, despite the external temperature being cold.

3.2.2.1 BROILERS

One of the major causes of death during transportation for broilers is thermal stress, accounting for around 40% of birds who are dead on arrival (Schwartzkopf-Genswein et al., 2012). Positioning in the truck also has an effect and can even result in birds within the same trailer suffering from both heat and cold stress (Jacobs et al., 2017b). Broilers are susceptible to heat stress because of the genetic selection for their muscle growth, which has reduced their ability to cope with heat stress (Cockram and Dulal, 2018). Heat stress is a distressing experience for the birds, and they are likely to experience respiratory distress and hyperventilate before collapsing (Cockram

and Dulal, 2018). Some may take hours to die from the experience, whereas others may die relatively quickly, depending on the conditions, their size, age, and body condition (Cockram and Dulal, 2018).

3.2.2.2 LAYING HENS

Due to their poor feather coverage and lighter weights, end-of-lay hens can be susceptible to cold stress, especially in the UK's temperate climate (Richards et al., 2012; Weeks et al., 2012). End-of-lay hens experience difficulties in thermoregulation, as they lack the energy and protein stores needed, and often suffer from poor feather coverage (Beaulac et al., 2020). Blood physiology parameters also show that hens who have heat stress during transportation experience stress and poor welfare as a result (Beaulac et al., 2020). Hens who are transported at the bottom level of the truck, under multiple layers of cages, are susceptible to an adverse microclimate, and often show increased measures of stress hormones and other indicators of physiological distress (Bozkurt, 2021).

3.2.3 NUMBER OF BIRDS AND SPACE ALLOWANCES

Loading density is considered to be a major cause of mortality in poultry during transportation, second to microclimate (Schwartzkopf-Genswein et al., 2012). There are several welfare concerns that can be exacerbated or improved by different stocking densities, and there is not always a clear answer as to what densities are optimal (Schwartzkopf-Genswein et al., 2012). The number of birds in each drawer, module and the entire truck can affect how well they cope with the temperatures and microclimate. For example, when conditions are freezing, fewer birds suffer from cold stress in higher densities, but overcrowding can cause birds to over-heating even in cold temperatures (Cockram and Dulal, 2018; Vecerkova et al., 2019). Both low and high stocking densities can also increase the likelihood of fighting, and of weaker birds becoming the victims of injurious attacks (Valkova et al., 2021b). Various studies have also shown that higher stocking densities result in more mortalities (Chauvin et al., 2011; Schwartzkopf-Genswein et al., 2012).

Any optimal loading density would need to vary in accordance with several factors, including temperatures, size of birds, and location in the trailer (Schwartzkopf-Genswein et al., 2012).

Feed withdrawal can also impact the effects of stocking density, and one study found that broilers are more likely to show physiological stress from feed withdrawal when transported at high loading densities (Delezie et al., 2007). Broilers also have higher cortisol concentrations when in high loading densities, compared with those transported in less crowded cages (Delezie et al., 2007). Chauvin et al. (2011) also found that mortality rates increased along with stocking densities in broilers, and they concluded that density was a critical factor in relation to the number of birds found dead on arrival.

Loading densities can also impact the comfort of birds during the journey, and both high and low densities can impact injuries. In their study, Jacobs et al. (2017a) found that 0.21% of the birds they assessed suffered crating discomfort upon loading, with heads, or other body parts, stuck in the walls of the crate. These instances may cause fractures, injuries, or fatalities, especially on longer journeys (Jacobs et al., 2017b).

3.3 OVERARCHING WELFARE ISSUES DURING TRANSPORTATION OF CHICKENS

3.3.1 FEED AND WATER WITHDRAWAL

Like many farmed animals, chickens tend to be fasted prior to transportation, as they are predominantly transported for slaughter. The birds are also likely to be deprived of water for the entire loading, transportation, and unloading process. Feed withdrawal can exacerbate other welfare issues during transportation, such as their ability to thermoregulate (Vecerkova et al., 2019). The effects of fasting are greater during cold conditions and fasted birds are at greater risk of hypothermia (Cockram and Dulal, 2018). Fasting can also make birds more aggressive to one another, resulting in more injuries and distress (Valkova et al., 2021b). Broilers who have been fasted for 13 hrs also show greater weight loss during transportation, compared with fed broilers (Delezie et al., 2007). Fasted broilers also show higher body temperatures, indicating increased stress levels, compared with individuals who are fed prior to transportation (Delezie et al., 2007).

Dehydration is another welfare concern during transportation, especially as birds are not typically provided with water during the journey. Some birds may already be dehydrated before loading, as smaller and injured individuals can have difficulty reaching the drinkers and feeders (Cockram and Dulal, 2018). The journey, and the often-increased temperatures they have to endure, then worsen their dehydration, which can cause fatalities (Cockram and Dulal, 2018). Water is also required for evaporative cooling, which chickens do via respiration to thermoregulate themselves, and so water withdrawal is a significant concern (Cockram and Dulal, 2018).

3.4 THE LONG-TERM EFFECTS OF TRANSPORTATION FOR CHICKENS

Most chickens are transported for slaughter, and so the long-term effects are not relevant for these individuals. Some may be transported for other purposes, such as for breeding and research, and chicks may be transported from hatcheries to farms. Day-old chicks who are transported can experience long-term effects from the experience and the various stressors involved. For example, if they are feed-deprived post-hatching until they arrive at their new destination, chicks show delayed weight gain for 21 days, compared with control chicks (Hollemans et al., 2018). Transported day-old chicks are also more fearful, compared with non-transported chicks, and the effect is long-term and can affect their ability to cope with other stressful events (Hollemans et al., 2018).

3.5 EMOTIONAL, FEELING CHICKENS

Chickens are not always given the credit they deserve, as they are either overlooked as key members of the taxonomic order of birds, or are viewed as commodities, rather than the sentient beings that they are (Marino, 2017). In fact, chickens are smarter and more sensitive than most people think. For example, like us, chickens do not want to feel pain, and they will opt for pain relief whenever its available. One study showed that lame chickens who were in pain opted for feed that was secretly laced with pain-relief medication, as they quickly made the association between food choices and pain relief (Danbury et al., 2010). Healthy birds did not show the same preferences, as they had no need for pain relief.

Heat and cold stress is a significant welfare issue for chickens during transportation, and chickens actually show a preference for warmer temperatures, compared with the cold, and the temperature they are kept in can affect their mood (Deakin et al., 2016).

Deakin et al. found that hens who were kept in a warm room were more likely to be optimistic, and make optimistic choices, compared with those kept in a cold room. When chickens are caught and loaded into the trailer for transportation, they may or may not be with familiar chickens. Who a chicken is transported with has important implications on their ability to cope with stressful events, as familiar chickens can help to buffer a chicken's emotional response.

For example, when chicks are subjected to a mild stressor, they react more emotionally when their mother is not there, compared with when she is (Edgar et al., 2015). Suggesting that the presence of a close conspecific provides a social buffering effect.

3.6 CONCLUSION

The stressors of transportation can have significant impacts both on chickens' physical well-being and also on their mental well-being. The two are intertwined, and a chicken's previous experiences can impact how well they cope with the stress of transportation. For instance, birds housed in enriched and varied environments are better able to cope with the stress of transportation, compared with birds who have been reared in unenriched conditions (Ross et al., 2020). The capacity of chickens to feel a wide range of emotions, including fear, pain, stress, and empathy, is highly relevant to their experience in transportation.

As this section has discussed, there are many ways in which the welfare of chickens can be impacted during transportation, and mortalities, injuries, and fractures are unfortunately common occurrences.

Broilers and end-of-lay hens are often in poor condition, which only exacerbates the stressors they experience during transportation, rendering them more susceptible to fractures, heat stress, and death.

The welfare of these sentient, feeling, and emotional beings is negatively impacted by transportation, as they are not adapted to cope with the challenges that transportation pose.

4 SHEEP AND LAMBS

Although transportation is known to be stressful for sheep and lambs, they have not received the same amount of scientific attention regarding their experiences in the different stages of transportation as other farmed animals. Much of the research focuses on live exports of sheep, which the UK Government has publicly committed to banning in legislation[7]. This is a significant positive, as there is considerable scientific evidence that shows the high degree of suffering that live exports cause sheep and lambs (Nielsen et al., 2011). The sections below cover the key welfare issues for sheep and lambs during transportation, utilising what scientific evidence is available.

4.1 WELFARE ISSUES ASSOCIATED WITH THE LOADING OF SHEEP AND LAMBS

The loading stage of transportation can be stressful for sheep and lambs, and any stress, injuries, or fatigue incurred, or experienced at this stage, can have lasting effects and impact on their experience on the journey. Sheep are prey animals, and so they are easily stressed and frightened when handled. Loading and the start of the driving are also considered to be the most physiologically stressful for sheep, and although these events occur at the start of the process, the stress responses are energy-consuming and can cause energy deprivation later in the journey (Broom et al., 1996; Nielsen et al., 2011)

Studies have found that sheep are stressed and have elevated heart rates during loading, no matter if they enter the truck by a ramp, or by a hydraulic lift, as both methods elicit similar levels of cortisol concentrations and elevate heart rates (Broom et al., 1996; Parrott et al., 1998). Loading via a ramp is stressful for sheep, but not as stressful as being shouted at and lifted manually, as evidenced by a marked increase in cortisol concentrations for manually loaded sheep, compared with ramp loading (Yardimci et al., 2013). Lambs also show significant increases in heart rate when loaded, compared with at rest, and their heart rates can remain

7 https://www.gov.uk/government/news/better-welfare-conditions-for-millions-of-farm-animals-during-transit

elevated throughout the transportation period (de la Fuente et al., 2012).

Sheep find loading stressful for several reasons. First, they are exposed to familiar and possibly unfamiliar humans, whom they may be instinctively fearful of (Wickham et al., 2012). Second, the exertion of moving, and navigating unfamiliar surfaces such as ramps and lifts, can be physiologically and psychologically stressful (Parrott et al., 1998). Third, they may be mixed with unfamiliar sheep, which is thought to be stressful but is an area that has been neglected in the scientific literature (Llonch et al., 2015). Fourth, for many, the truck will be a completely new environment for them, and sheep are naturally neophobic and find new environments stressful and frightening (Messori et al., 2015). And last, the way sheep are loaded can impact their wellbeing, and some traditional methods, including using dogs, shouting, and lifting, are considerably stressful for sheep (Yardimci et al., 2013).

4.2 WELFARE ISSUES ASSOCIATED WITH THE JOURNEY FOR SHEEP AND LAMBS

Sheep and lambs are highly sensitive to stress and are nervous animals (Valkova et al., 2021a). This not only means that drivers need to take extra care when transporting these animals, but it means that the unavoidable stressors present throughout transportation have a considerable impact on their welfare. The following sections discuss the specific welfare concerns during the journey that apply to sheep and lambs.

4.2.1 JOURNEY LENGTH AND DURATION

The length of the journey, or the duration of time that passes between loading and unloading, does not always have a straightforward relationship, and longer journeys are not always worse in terms of the various welfare measures. Furthermore, the factors affecting the welfare of sheep during a journey are all interrelated, and factors such as environmental conditions, periods of fasting, and trailer design can impact the effects of the journey duration.

The following is a discussion of the various impacts of different journey durations and shows that both short and long journeys can have different, yet significant, welfare impacts upon sheep and lambs.

4.2.1.1 LAMBS

In terms of stress levels and heart rate, lambs appear to acclimatise more to the experience of transportation on longer journeys, compared to on shorter journeys. Some studies have found

that shorter journeys of under 2 hours do not give lambs long enough to recover from the loading experience, as they still have elevated heart rates at unloading (de la Fuente et al., 2012). Whereas lambs who are on longer journeys tend to lie down, resulting in reduced heart rates and cortisol levels (de la Fuente et al., 2012). Whereas in a comparison of lamb welfare on 1hr versus 2hr journeys in cold temperatures, researchers found that cortisol concentrations were higher for the 2hr journey, compared with the 1hr journey, suggesting that there are many effects at play here (Carnovale et al., 2021). They also found that physiological measures of muscular damage showed that the 2hr journey had more negative impacts on the lambs, compared with the 1hr journey. They suggest that this may be because the risk of lambs bumping into one another increased with time, especially as they became more fatigued (Carnovale et al., 2021). Other physiological indicators showed more of an effect in the longer journeys, including increased metabolism due to stress, intense muscular activity from shivering, and increased levels of adrenaline. Their findings suggest that all the sheep in the 2hr journey entered a period of physiological stress by the end (Carnovale et al., 2021).

Very long journeys of over 22hrs also have effects on the welfare of lambs, even with rest stops. For example, lambs show signs of food deprivation and dehydration from long journeys, as well as weight loss (Nielsen et al., 2011). These effects are significantly exacerbated when environmental conditions become challenging, as sheep are susceptible to heat stress (see section 2.2.2) (Cockram, 2007).

4.2.1.2 SHEEP

In lambs, relatively short journeys can have significant effects on their welfare, and the same applies to adult sheep. In one study, ewes who were transported for 4 hours showed several welfare impacts in comparison with the control, untransported ewes (Pascual-Alonso et al., 2017). In particular, the transported ewes lost approximately 1 kg of live weight, had higher body temperatures for 12 hrs post-transport, and showed a range of physiological indicators of stress, fatigue, and immune suppression at unloading, compared with the control ewes (Pascual-Alonso et al., 2017). The transported ewes also behaved differently post-transport, as they ate before drinking, and rested less for the first 3 hrs after unloading, compared with the control sheep (Pascual-Alonso et al., 2017).

In terms of long-distance journeys ranging from 12 – 48hrs, adult sheep show increased loss of body weight as journey duration increases, along with physiological signs of dehydration (Fisher et al., 2010). Although the researchers from this study suggest that these levels are within the realms of normal losses, there is no consideration for the experience of starvation and dehydration in the sheep being transported.

4.2.1.3 REST STOPS

Providing sheep with rest stops on long journeys is often considered to be beneficial for welfare, in order to mitigate the effects of long-distance transportation (Messori et al., 2015). Given that the processes of loading and unloading are inherently stressful for sheep, rest stops may

not be that beneficial in terms of sheep welfare. In fact, sheep show detrimental welfare impacts from transportation, regardless of whether they have a rest stop, or whether the rest stop is on the truck or off the truck (Messori et al., 2015). There are some short-term welfare benefits of rest stops, but these are mitigated by other factors, including the stress experienced during additional unloading and loading procedures.

4.2.2 TRAILER MICROCLIMATE

Following the exertion and raised body temperatures caused by loading, the humidity, and temperature in the trailer can rise quickly (Miranda-de la Lama et al., 2011). Rising temperatures and humidity levels then stimulate the sheep to begin evaporative heat loss by panting, which then creates a microclimate that can cause dehydration (Pascual-Alonso et al., 2017). Dangerous microclimates can occur in both long and short journeys and are affected by several factors, including the number of sheep, truck design, and position within the truck (Miranda-de la Lama et al., 2010; Pascual-Alonso et al., 2017).

4.2.3 NUMBER OF SHEEP AND SPACE ALLOWANCES

Lambs tend to lie down during transportation, and bouts of standing can be a sign of discomfort or disturbance, including rough roads, poor driving style, and sub-optimal space allowances (de la Fuente et al., 2012). For instance, lambs are more likely to lie down when they have more space, compared with lower space allowances (de la Fuente et al., 2012). Lambs also prefer to lie down in contact with other lambs, which differs from adult sheep, who prefer to stand next to, but not touch other sheep (de la Fuente et al., 2012; Jones et al., 2010). Consequently, on long journeys, lambs can have higher heart rates when kept in high densities, compared with in low densities, as they are less likely to rest, and have the space to lie down (de la Fuente et al., 2012).

Some suggest that sheep need to be kept at high densities during transportation, as this reduces their chances of slipping and falling, and legislation and regulations are often based on this theory (Jones et al., 2010). Research shows that sheep prefer lower densities during transportation, as they prefer to adopt a wide leg stance to brace themselves against the motion of the vehicle (Jones et al., 2010). Sheep lose their balance more, slip, and fall more when they have the space to do this and to remain close to, but not touching other individuals (Jones et al., 2010). Sheep will also choose to lie more when they have the space to do so, which can improve their welfare (Jones et al., 2010).

4.2.4 DRIVING STYLE

Rough roads and varied speeds also affect lambs' comfort and behaviour on a journey, and lambs are more likely to lie down when the road and speed are more standardised (de la Fuente et al., 2012). In one study where sheep were transported using a stop-start driving style or by a smooth driving style, assessors found the sheep to be more alert, anxious, and nervous with the stop-start style (Wickham et al., 2012). These behavioural observations were supported by a range of physiological indicators, including higher cortisol concentrations, core body temperatures, and white blood cells for the stop-start driving style, compared with lower

levels recorded for the smooth driving style (Wickham et al., 2012). Both the physiological and the behavioural measures showed that all the sheep found transportation stressful, but that the stop-start driving style was the most stressful.

Both driver behaviour and driving events in a journey can significantly impact the welfare of sheep during transportation.

For example, most instances where sheep lose their balance during a journey are because of driving events such as acceleration, cornering, and braking (Cockram et al., 2004).

This can cause falls, and then potentially injuries for the sheep, but driving style is also known to limit the opportunities for rest and rumination, which are critical for the welfare of the sheep (Cockram et al., 2004).

4.3 WELFARE ISSUES ASSOCIATED WITH THE UNLOADING OF SHEEP AND LAMBS

As sheep have been relatively understudied, compared with other farmed animals, there is little scientific discussion around specific welfare impacts of unloading. The same concerns apply as during loading though, and the exertion of being driven into lairage, having to navigate a ramp, and the fear of new environments can all impact sheep welfare (Llonch et al., 2015; Pascual-Alonso et al., 2017). Furthermore, the sheep have to cope with these stressors following a stressful journey, where they may have incurred injuries, have been deprived of feed and water for some time, or experienced heat or cold stress, all of which would render them less able to cope with the stressors of unloading (Grandin and Shivley, 2015; Pascual-Alonso et al., 2017).

4.4 OVERARCHING WELFARE ISSUES DURING TRANSPORTATION OF SHEEP AND LAMBS

4.4.1 FEED AND WATER WITHDRAWAL

Sheep and lambs are often fasted prior to transportation, especially if they are destined for slaughter. They are then often only given water on a journey if it includes a rest stop. The period of feed and water withdrawal can often be considerable. Although studies have explored the physiological tolerance of this for sheep, little thought has been given to their subjective experience of prolonged hunger and dehydration (Fisher et al., 2010). The behaviour of sheep and lambs following transportation clearly shows that they are highly driven to resume feeding and drinking, suggesting a degree of urgency for tending to these needs (Pascual-Alonso et al., 2017). Researchers have found that the emotional mood of sheep is negatively affected by feed restriction and that they are more pessimistic and make pessimistic choices when fed on a feed-restricted diet (Verbeek et al., 2014). Whereas sheep who are fed on a high feeding regime were more optimistic, as evidenced by their optimistic judgments in relation to a training paradigm (Verbeek et al., 2014).

4.5 THE LONG-TERM EFFECTS OF TRANSPORTATION FOR SHEEP AND LAMBS

Transportation increases the risk of disease transmission between sheep, especially if they are mixed with unfamiliar individuals, and this can have long-term impacts on the health and welfare of sheep who are transported for reasons other than slaughter (Cockram, 2007). Sheep and lambs also take some time to regain the lost body weight from transportation, and the return of various physiological indicators of stress is not immediate and can also take hours to return to baseline levels (Parrott et al., 1998; Pascual-Alonso et al., 2017).

The stressful experience of transportation can also have long-term impacts on the mood of sheep. Stressed sheep who had experienced various stressors, including transportation, were found to be more pessimistic compared to unstressed sheep (Doyle et al., 2011). In particular, sheep were tested in a judgement bias paradigm, where they were trained to approach a positive (feed reward) location cue, and to not approach a negative (blowing fan) location cue. Half of the sheep were then subjected to stressful and unpredictable events, including transportation and other events, such as individual restraint, feed withdrawal, and sham shearing.

The sheep were then tested with ambiguous location cues situated between the positive and negative conditioned locations. The stressed sheep were significantly less likely to approach the ambiguous location cue, exhibiting pessimistic judgments, compared to the control sheep who were more optimistic about the ambiguous cue (Doyle et al., 2011).

4.6 EMOTIONAL, FEELING SHEEP

Sheep are sentient beings, but they are also complex, individual, and highly social animals, who can feel and suffer, and feel pleasure and joy (Marino and Merskin, 2019). Sheep are highly social animals, and they know who is who in their herd. In fact, studies have found that sheep can remember at least 50 different sheep faces for over 2 years (Kendrick et al., 2001). It is not just fellow sheep they can recognise though; sheep can remember the face of their handler from a picture and can be trained to recognise unfamiliar human faces in photographs too (Knolle et al., 2017). Their face-recognition abilities are comparable to humans and monkeys and are truly remarkable.

Sheep will often yawn if they see another sheep yawning and will often synchronise rumination with one another. This is evidence of emotional contagion, and a recognition of another's emotional state and perspective. This is an important consideration for the treatment of sheep during transportation, as one sheep who is feeling stressed and frightened can passively influence the emotional state of other sheep (Reimert et al., 2017). Furthermore, emotional contagion is thought to be a building block for empathy and may indicate that sheep are capable of higher degrees of empathy. Another indication of empathy in sheep is the fact that ewes pay more attention to their lambs when the lambs show signs they are in pain (Hild et al., 2011). We may look at a sheep's face and not be able to tell much about how they are feeling, but sheep actually have relatively expressive faces. Scientists have even developed a grimace scale for sheep, which uses their facial expressions to determine the severity of pain they are experiencing (McLennan et al., 2016) This is important for improving their welfare and managing painful conditions. Sheep also communicate their feelings through their ear postures. For example, when in pain, lambs spend longer with their ears held backward, and move their ears less, compared with when they are pain-free (Guesgen et al., 2016).

Sheep are also known to perform certain ear postures more in response to different emotional states, from positive excitement, to distress, fear, and frustration (Boissy et al., 2011; Reefmann et al., 2009b, 2009a).

4.7 CONCLUSION

Compared with other farmed animals, there has been far less scientific investigation into the experiences and welfare of sheep during transportation. What research there is though, highlights that not only do sheep find transportation to be a stressful experience, but that they show subjective and physiological signs of poor welfare from both short and long journeys, and some of these effects are long-lasting. Lambs represent a considerable number of the sheep being transported, and they are still very young animals when they are being transported for slaughter. Yet, there has been little consideration in the scientific literature for the specific impacts on them regarding the stress of transportation and the many new experiences and risks that they face. Sheep are sensitive animals, and the many stressors they experience during transportation pose considerable risks to their physical and mental well-being.

AFTERWORD BY ANIMAL JUSTICE PROJECT

Animal Justice Project's 'Lives Not Stock' campaign raises awareness of animal transport, a stressful and terrifying ordeal for billions of farmed animals every year. They are pushed, slapped and goaded onto huge trucks (often several decks high) by handlers who routinely instill fear. Their wellbeing is secondary to their usefulness as 'products'.

On motorways, we see the faces of animals staring out from transporters, but what do these individuals really experience? From just five weeks old, chickens will still be cheeping like babies from bright yellow crates with thousands of others; pigs just six months old, but already fat enough for slaughter, will be crammed in with other pigs they don't know, unable to sweat and control their body temperature. A nightmare on hot summer days. Tiny calves, barely able to stand and still desperate for their mothers' milk, may be unlucky enough to find themselves on the long journey overseas to the continent for veal. Ireland continues to ship over 150,000 unweaned calves a year.

This report, drawing on evidence from peer-reviewed research, paints a bleak picture and provides further evidence that UK legislation, such as the Animal Welfare (Kept Animals) Bill and Animal Welfare Act 2006, will do little to ease the pain and suffering endured by animals in transit. This is particularly true for those left out of legislation entirely, like the billions of chicks exported each year. Farmed animals, it concludes, suffer regardless of journey length, how much head room they are afforded, and supermarket-assured standards. Suffering is intrinsic to any journey.

Well-publicised changes within UK law, whilst bringing a welcome end to live export of animals for fattening and slaughter, fail to consider the thousands of animals exported for breeding purposes. The legislation only covers larger farmed animals, leaving millions of chickens, ducks, turkeys and other birds to continue their perilous journeys overseas. 98 percent of animals sent overseas will remain unaffected by the ban. Should we be surprised? Historically, laws have succeeded in protecting the profits of the exploiters, rather than the exploited. Transport takes away an animal's autonomy, so it is therefore, by its very nature, a violation of their rights. Welfare assurances and reforms consistently fail animals.

The legislation also effectively makes no change for animals sent to slaughterhouses for supermarkets, many of which already provision an 8-hour journey limit.

This report goes into detail about the experiences of animals, as whilst weather changes, small space allowance, thermal stress, injuries from other animals, even death on transporters can occur to all, each species is adapted differently to their environment. Pigs, for example, find all aspects of transportation stressful, particularly loading. Painful electric prods may be used, and the separation and mixing with unfamiliar individuals affects pigs very badly. Dairy cows, considered useless when they produce lower yields of milk for their babies, are often in physically poor condition on journeys to the abattoir, suffering bruising and difficulties trying to stand as they are thrown back and forth. Chickens, with their grossly oversized bodies, or exhausted from egg laying, may have damaged wings or legs from being caught on farms by catching teams. Even short journeys will be terrifying and painful experiences.

Regardless of the animal or journey, there is no escaping the fact that there will be avoidable suffering. Avoidable because we, as consumers, have the ultimate power to stop the trucks in their tracks. By not consuming the flesh or secretions of animals, the journeys would never start in the first place.

REFERENCES

Acevedo-Giraldo, J.D., Sánchez, J.A., Romero, M.H., 2020. Effects of feed withdrawal times prior to slaughter on some animal welfare indicators and meat quality traits in commercial pigs. Meat Sci 167, 107993. https://doi.org/10.1016/j.meatsci.2019.107993

Beaulac, K., Crowe, T.G., Schwean-Lardner, K., 2020. Simulated transport of well- and poor-feathered brown-strain end-of-cycle hens and the impact on stress physiology, behavior, and meat quality. Poultry Science 99, 6753–6763. https://doi.org/10.1016/J.PSJ.2020.09.051

Benincasa, N.C., Sakamoto, K.S., Silva, I.J.O., Lobos, C.M.V., 2020. Animal welfare: impacts of pre-slaughter operations on the current poultry industry. Journal of Animal Behaviour and Biometeorology 8, 104–110. https://doi.org/10.31893/jabb.20014

Bertenshaw, C., Rowlinson, P., 2008. Exploring heifers' perception of "positive" treatment through their motivation to pursue a retreated human. Animal Welfare 17, 313–319.

Bertol, T.M., Ellis, M., Ritter, M.J., McKeith, F.K., 2005. Effect of feed withdrawal and handling intensity on longissimus muscle glycolytic potential and blood measurements in slaughter weight pigs. Journal of Animal Science 83, 1536–1542. https://doi.org/10.2527/2005.8371536x

Boissy, A., Aubert, A., Desire, L., 2011. Cognitive sciences to relate ear postures to emotions in sheep. Animal Welfare 20, 47–56.

Boissy, A., Terlouw, C., Le Neindre, P., 1998. Presence of cues from stressed conspecifics increases reactivity to aversive events in cattle: Evidence for the existence of alarm substances in urine. Physiology and Behavior 63, 489–495. https://doi.org/10.1016/S0031-9384(97)00466-6

Bozkurt, Z., 2021. Effect of Crating Position During Transport on Welfare and Oxidative Stress in Laying Hens. Kocatepe Veterinary Journal 14, 458–466. https://doi.org/10.30607/KVJ.985794

Bracke, M.B.M., Herskin, M.S., Marahrens, M., Gerritzen, M.A., Spoodler, H.A.M., 2020. Review of climate control and space allowance during transport of pigs (version 1.0). EURCAW Pigs 1–34.

Bradshaw, R.H., Parrott, R.F., Forsling, M.L., Goode, J.A., Lloyd, D.M., Rodway, R.G., Broom, D.M., 1996. Stress and travel sickness in pigs: Effects of road transport on plasma concentrations of cortisol, beta-endorphin and lysine vasopressin. Animal Science 63, 507–516. https://doi.org/10.1017/S135772980001540X

Bravo, V., Gallo, C., Acosta-Jamett, G., 2018. Effects of short transport and prolonged fasting in beef calves. Animals 8, 1–9. https://doi.org/10.3390/ani8100170

Bravo, V.M., Knowles, T.G., Gallo, C., 2020. Transport, Associated Handling Procedures and Auction Markets. Animals 10, 13.

Breuer, K., Hemsworth, P., Barnett, J., Matthews, L., Coleman, G., 2000. Behavioural response to humans and the productivity of commercial dairy cows. Applied Animal Behaviour Science 66, 273–288.

Broom, D.M., Goode, J.A., Hall, S.J.G., Lloyd, D.M., Parrott, R.F., 1996. Hormonal and physiological effects of a 15 hour road journey in sheep: comparison with the responses to loading, handling and penning in the absence of transport. British Veterinary Journal. https://doi.org/10.1016/S0007-1935(96)80011-X

Burdick, N.C., Randel, R.D., Carroll, J.A., Welsh, T.H., 2011. Interactions between Temperament, Stress, and Immune Function in Cattle. International Journal of Zoology 2011, 1–9. https://doi.org/10.1155/2011/373197

Carnovale, F., Xiao, J., Shi, B., Kaart, T., Arney, D., Phillips, C.J.C., 2021. The effects of vehicle type, transport duration and pre-transport feeding on the welfare of sheep transported in low temperatures. Animals 11. https://doi.org/10.3390/ani11061659

Çavuşoğlu, E., Petek, M., 2021. Effects of season, plumage colour and transport distance on body weight loss, dead-on-arrival and reject rate in commercial end-of-lay hens. Animals 11, 1–11. https://doi.org/10.3390/ani11061827

Chauvin, C., Hillion, S., Balaine, L., Michel, V., Peraste, J., Petetin, I., Lupo, C., Le Bouquin, S., 2011. Factors associated with mortality of broilers during transport to slaughterhouse. animal 5, 287–293. https://doi.org/10.1017/S1751731110001916

Chloupek, P., Vecerek, V., Voslarova, E., Bedanova, I., Suchy, P., Pistekova, V., Kozak, A., 2008. Effects of different crating periods on selected biochemical indices in broiler chickens. Berliner und Munchener Tierarztliche Wochenschrift 121, 132–136. https://doi.org/10.2376/0005-9366-121-132

Cockram, M., 2020. Condition of animals on arrival at the abattoir and their management during lairage., in: The Slaughter of Farmed Animals: Practical Ways of Enhancing Animal Welfare. CABI, pp. 49–77. https://doi.org/10.1079/9781789240573.0049

Cockram, M.S., 2021. INVITED REVIEW: The welfare of cull dairy cows. Applied Animal Science 37, 334–352. https://doi.org/10.15232/aas.2021-02145

Cockram, M.S., 2019. Fitness of animals for transport to slaughter. Canadian Veterinary Journal.

Cockram, M.S., 2007. Criteria and potential reasons for maximum journey times for farm animals destined for slaughter. Applied Animal Behaviour Science 106, 234–243. https://doi.org/10.1016/j.applanim.2007.01.006

Cockram, M.S., Baxter, E.M., Smith, L.A., Bell, S., Howard, C.M., Prescott, R.J., Mitchell, M.A., 2004. Effect of driver behaviour, driving events and road type on the stability and resting behaviour of sheep in transit. Animal Science 79, 165–176. https://doi.org/10.1017/S1357729800054631

Cockram, M.S., Dulal, K.J., 2018. Injury and mortality in broilers during handling and transport to slaughter. Canadian Journal of Animal Science 98, 416–432. https://doi.org/10.1139/cjas-2017-0076

Correa, J.A., Gonyou, H., Torrey, S., Widowski, T., Bergeron, R., Crowe, T., Laforest, J.P., Faucitano, L., 2014. Welfare of pigs being transported over long distances using a pot-belly trailer during winter and summer. Animals 4, 200–213. https://doi.org/10.3390/ani4020200

Correa, J.A., Gonyou, H.W., Torrey, S., Widowski, T., Bergeron, R., Crowe, T.G., Laforest, J.P., Faucitano, L., 2013. Welfare and carcass and meat quality of pigs being transported for two hours using two vehicle types during two seasons of the year. Canadian Journal of Animal Science 93, 43–55. https://doi.org/10.4141/CJAS2012-088

Correa, J.A., Torrey, S., Devillers, N., Laforest, J.P., Gonyou, H.W., Faucitano, L., 2010. Effects of different moving devices at loading on stress response and meat quality in pigs. Journal of Animal Science 88, 4086–4093. https://doi.org/10.2527/jas.2010-2833

Dahl-Pedersen, K., Herskin, M.S., Houe, H., Thomsen, P.T., 2018. A descriptive study of the clinical condition of cull dairy cows before transport to slaughter. Livestock Science 218, 108–113. https://doi.org/10.1016/j.livsci.2018.11.001

Dalla Costa, F.A., Da Costa, M.J.R.P., Faucitano, L., Dalla Costa, O.A., Lopes, L.S., Renuncio, E., 2016. Ease of handling, physiological response, skin lesions and meat quality in pigs transported in two truck types. Archivos de Medicina Veterinaria 48, 299–304. https://doi.org/10.4067/S0301-732X2016000300009

Damtew, A., Erega, Y., Ebrahim, H., Tsegaye, S., Msigie, D., 2018. The Effect of long Distance Transportation Stress on Cattle: a Review. Biomedical Journal of Scientific & Technical Research 3, 1–5. https://doi.org/10.26717/bjstr.2018.03.000908

Danbury, T.C.C., Weeks, C.A.A., Waterman-Pearson, A.E.E., Kestin, S.C.C., Chambers, J.P.P., Kestin, S.C.C., Weeks, C.A.A., Danbury, T.C.C., 2010. Self-selection of the analgesic drug carprofen by lame broiler chickens. Veterinary Record 146, 307–311. https://doi.org/10.1136/vr.146.11.307

Daros, R.R., Costa, J.H.C.C., Von Keyserlingk, M.A.G.G., Hötzel, M.J., Weary, D.M., 2014. Separation from the dam causes negative judgement bias in dairy calves. PLoS ONE 9, 5–9. https://doi.org/10.1371/journal.pone.0098429

de la Fuente, J., de Chávarri, E.G., Sánchez, M., Vieira, C., Lauzurica, S., Díaz, M.T., Pérez, C., 2012. The effects of journey duration and space allowance on the behavioural and biochemical measurements of stress responses in suckling lambs during transport to an abattoir. Applied Animal Behaviour Science 142, 30–41. https://doi.org/10.1016/j.applanim.2012.08.010

de Oliveira, D., Keeling, L.J., 2018. Routine activities and emotion in the life of dairy cows: Integrating body language into an affective state framework. PLoS ONE 13, 1–16. https://doi.org/10.1371/journal.pone.0195674

Deakin, A., Browne, W.J., Hodge, J.J.L., Paul, E.S., Mendl, M., 2016. A screen-peck task for investigating cognitive bias in laying hens. PLoS ONE 11, 1–13. https://doi.org/10.1371/journal.pone.0158222

Delezie, E., Swennen, Q., Buyse, J., Decuypere, E., 2007. The effect of feed withdrawal and crating density in transit on metabolism and meat quality of broilers at slaughter weight. Poultry Science 86, 1414–1423. https://doi.org/10.1093/ps/86.7.1414

Dokmanović, M., Velarde, A., Tomović, V., Glamočlija, N., Marković, R., Janjić, J., Baltić, M.Z., 2014. The effects of lairage time and handling procedure prior to slaughter on stress and meat quality parameters in pigs. Meat Science 98, 220–226. https://doi.org/10.1016/j.meatsci.2014.06.003

dos Santos, V.M., Dallago, B.S.L., Racanicci, A.M.C., Santana, .P., Cue, R.I., Bernal, F.E.M., 2020. Effect of transportation distances, seasons and crate microclimate on broiler chicken production losses. PLoS ONE 15, 1–22. https://doi.org/10.1371/journal.pone.0232004

Doyle, R.E., Lee, C., Deiss, V., Fisher, A.D., Hinch, G.N., Boissy, A., 2011. Measuring judgement bias and emotional reactivity in sheep following long-term exposure to unpredictable and aversive events. Physiology and Behavior 102, 503–510. https://doi.org/10.1016/j.physbeh.2011.01.001

Driessen, B., Peeters, E., Thielen, J. Van, Beirendonck, S. Van, 2013. Practical handling skills during road transport of fattening pigs from farm to slaughterhouse: A brief review. Agricultural Sciences 04, 756–761. https://doi.org/10.4236/as.2013.412103

Earley, B., Buckham Sporer, K., Gupta, S., 2017. Invited review: Relationship between cattle transport, immunity and respiratory disease. Animal 11, 486–492. https://doi.org/10.1017/S1751731116001622

Edgar, J., Held, S., Paul, E., Pettersson, I., l'Anson Price, R., Nicol, C., 2015. Social buffering in a bird. Animal Behaviour 105, 11–19. https://doi.org/10.1016/j.anbehav.2015.04.007

Edwards, L.N., Engle, T.E., Grandin, T., Ritter, M.J., Sosnicki, A.A., Carlson, B.A., Anderson, D.B., 2011. The effects of distance traveled during loading, lairage time prior to slaughter, and distance traveled to the stunning area on blood lactate concentration of pigs in a commercial packing plant. Professional Animal Scientist 27, 485–491. https://doi.org/10.15232/S1080-7446(15)30523-4

Edwards, L.N., Grandin, T., Engle, T.E., Porter, S.P., Ritter, M.J., Sosnicki, A.A., Anderson, D.B., 2010. Use of exsanguination blood lactate to assess the quality of pre-slaughter pig handling. Meat Science 86, 384–390. https://doi.org/10.1016/j.meatsci.2010.05.022

Faucitano, L., 2018. Preslaughter handling practices and their effects on animal welfare and pork quality. Journal of Animal Science 96, 728–738. https://doi.org/10.1093/jas/skx064

Fisher, A.D., Niemeyer, D.O., Lea, J.M., Lee, C., Paull, D.R., Reed, M.T., Ferguson, D.M., 2010. The effects of 12, 30, or 48 hours of road transport on the physiological and behavioral responses of sheep. Journal of Animal Science 88, 2144–2152. https://doi.org/10.2527/jas.2008-1674

Fisher, A.D., Stevens, B.H., Conley, M.J., Jongman, E.C., Lauber, M.C., Hides, S.J., Anderson, G.A., Duganzich, D.M., Mansell, P.D., 2014. The effects of direct and indirect road transport consignment in combination with feed withdrawal in young dairy calves. Journal of Dairy Research 81, 297–303. https://doi.org/10.1017/S0022029914000193

Garcia, A., McGlone, J.J., 2014. Loading and unloading weaned pigs: Effects of bedding types, ramp angle, and bedding moisture. Animals 4, 742–754. https://doi.org/10.3390/ANI4040742

Garcia, A., Pirner, G., Picinin, G., May, M., Guay, K., Backus, B., Sutherl, M., McGlone, J., 2015. Effect of provision of feed and water during transport on the welfare of weaned pigs. Animals 5, 407–425. https://doi.org/10.3390/ani5020363

Gebresenbet, G., Aradom, S., Bulitta, F.S., Hjerpe, E., 2011. Vibration levels and frequencies on vehicle and animals during transport. Biosystems

Engineering 110, 10–19. https://doi.org/10.1016/j.biosystemseng.2011.05.007

Gebresenbet, G., Wikner, I., Yaovi, E., Bobobee, H., Maria, G., Villarroel, M., 2012. Effect of Transport Time and Handling on Physiological Responses of Cattle. Journal of Agricultural Science and Technology A 2, 800–814.

Gerpe, C., Stratmann, A., Bruckmaier, R., Toscano, M.J., 2021. Examining the catching, carrying, and crating process during depopulation of end-of-lay hens. Journal of Applied Poultry Research 30, 100115. https://doi.org/10.1016/j.japr.2020.100115

Goetz, H.M., Winder, C.B., Costa, J.H.C., Creutzinger, K.C., Uyama, T., Kelton, D.F., Dunn, J., Renaud, D.L., 2022. Characterizing the literature surrounding transportation of young dairy calves: A scoping review. Journal of Dairy Science 105, 1555–1572. https://doi.org/10.3168/jds.2021-21211

González, L.A., Schwartzkopf-Genswein, K.S., Bryan, M., Silasi, R., Brown, F., 2012a. Relationships between transport conditions and welfare outcomes during commercial long haul transport of cattle in North America. J Anim Sci 90, 3640–3651. https://doi.org/10.2527/jas.2011-4796

González, L.A., Schwartzkopf-Genswein, K.S., Bryan, M., Silasi, R., Brown, F., 2012b. Factors affecting body weight loss during commercial long haul transport of cattle in North America. Journal of Animal Science 90, 3630–3639. https://doi.org/10.2527/jas.2011-4786

Goumon, S., Bergeron, R., Faucitano, L., Crowe, T., Connor, M.L., Gonyou, H.W., 2013a. Effect of previous ramp exposure and regular handling on heart rate, ease of handling and behaviour of near market-weight pigs during a simulated loading. Canadian Journal of Animal Science 93, 461–470. https://doi.org/10.4141/CJAS2013-166/ASSET/IMAGES/CJAS2013-166TAB2.GIF

Goumon, S., Brown, J.A., Faucitano, L., Bergeron, R., Crowe, T., Connor, M.L., Gonyou, H.W., 2013b. Effect of rest duration on recovery from repeated exercise in near-market-weight pigs. Journal of Animal Science 91, 5859–5867. https://doi.org/10.2527/jas.2012-6184

Goumon, S., Faucitano, L., 2017. Influence of loading handling and facilities on the subsequent response to pre-slaughter stress in pigs. Livestock Science 200, 6–13. https://doi.org/10.1016/j.livsci.2017.03.021

Goumon, S., Špinka, M., 2016. Emotional contagion of distress in young pigs is potentiated by previous exposure to the same stressor. Animal Cognition 19, 501–511. https://doi.org/10.1007/s10071-015-0950-5

Grandin, T., Shivley, C., 2015. How farm animals react and perceive stressful situations such as handling, restraint, and transport. Animals 5, 1233–1251. https://doi.org/10.3390/ani5040409

Guesgen, M.J., Beausoleil, N.J., Minot, E.O., Stewart, M., Stafford, K.J., Morel, P.C.H., 2016. Lambs show changes in ear posture when experiencing pain. Animal Welfare 25, 171–177. https://doi.org/10.7120/09627286.25.2.171

Hagen, K., Broom, D.M., 2004. Emotional reactions to learning in cattle. Applied Animal Behaviour Science 85, 203–213. https://doi.org/10.1016/j.applanim.2003.11.007

Hamilton, D.N., Ellis, M., Bertol, T.M., Miller, K.D., 2004. Effects of handling intensity and live weight on blood acid-base status in finishing pigs. Journal of Animal Science 82, 2405–2409. https://doi.org/10.2527/2004.8282405x

Held, S., Mendl, M., Devereux, C., Byrne, R.W., 2000. Social tactics of pigs in a competitive foraging task: The “informed forager” paradigm. Animal Behaviour 59, 569–576. https://doi.org/10.1006/anbe.1999.1322

Hild, S., Clark, C.C.A., Dwyer, C.M., Murrell, J.C., Mendl, M., Zanella, A.J., 2011. Ewes are more attentive to their offspring experiencing pain but not stress. Applied Animal Behaviour Science 132, 114–120. https://doi.org/10.1016/J.APPLANIM.2011.04.003

Hollemans, M.S., De Vries, S., Lammers, A., Clouard, C., 2018. Effects of early nutrition and transport of 1-day-old chickens on production performance and fear response. Poultry Science 97, 2534–2542. https://doi.org/10.3382/PS/PEY106

Horback, K., 2014. Nosing Around: Play in Pigs. Animal Behavior and Cognition 2, 186. https://doi.org/10.12966/abc.05.08.2014

Huertas, S.M., Kempener, R.E.A.M., van Eerdenburg, F.J.C.M., 2018. Relationship between methods of loading and unloading, carcass bruising, and animal welfare in the transportation of extensively reared beef cattle. Animals 8, 3–10. https://doi.org/10.3390/ani8070119

Jacobs, L., Delezie, E., Duchateau, L., Goethals, K., Tuyttens, F.A.M., 2017a. Impact of the separate pre-slaughter stages on broiler chicken welfare. Poultry Science 96, 266–273. https://doi.org/10.3382/ps/pew361

Jacobs, L., Delezie, E., Duchateau, L., Goethals, K., Tuyttens, F.A.M., 2017b. Animal well-being and behavior: Broiler chickens dead on arrival: Associated risk factors and welfare indicators. Poultry Science 96, 259–265. https://doi.org/10.3382/ps/pew353

Johnson, A.K., Sadler, L.J., Gesing, L.M., Feuerbach, C., Hill, H., Faga, M., Bailey, R., Stalder, K.J., Ritter, M.J., 2010. Effects of Facility System Design on the Stress Responses and Market Losses of Market Weight Pigs During Loading and Unloading1. Professional Animal Scientist 26, 9–17. https://doi.org/10.15232/S1080-7446(15)30553-2

Jones, T.A., Waitt, C., Dawkins, M.S., 2010. Sheep lose balance, slip and fall less when loosely packed in transit where they stand close to but not touching their neighbours. Applied Animal Behaviour Science 123, 16–23. https://doi.org/10.1016/j.applanim.2009.12.006

Jongman, E.C., Butler, K.L., 2014. The effect of age, stocking density and flooring during transport on welfare of young dairy calves in Australia. Animals 4, 184–189. https://doi.org/10.3390/ani4020184

Kanitz, E., Otten, W., Tuchscherer, M., 2005. Central and peripheral effects of repeated noise stress on hypothalamic–pituitary–adrenocortical axis in pigs. Livestock Production Science 94, 213–224. https://doi.org/10.1016/J.LIVPRODSCI.2004.12.002

Kendrick, K.M., da Costa, a P., Leigh, a E., Hinton, M.R., Peirce, J.W., 2001. Sheep don't forget a face. Nature 414, 165–6. https://doi.org/10.1038/35102669

Kephart, K.B., Harper, M.T., Raines, C.R., 2010. Observations of market pigs following transport to a packing plant. Journal of Animal Science 88, 2199–2203. https://doi.org/10.2527/jas.2009-2440

Kittelsen, K.E., Granquist, E.G., Aunsmo, A.L., Moe, R.O., Tolo, E., 2018. An evaluation of two different broiler catching methods. Animals 8, 1–9. https://doi.org/10.3390/ani8080141

Knolle, F., Goncalves, R.P., Jennifer Morton, A., 2017. Sheep recognize familiar and unfamiliar human faces from two-dimensional images. Royal Society Open Science 4. https://doi.org/10.1098/RSOS.171228

Lambert, H.S., Carder, G., 2019. Positive and negative emotions in dairy cows: Can ear postures be used as a measure? Behavioural Processes 158, 172–180. https://doi.org/10.1016/j.beproc.2018.12.007

Lambert, H.S., Carder, G., 2016. Looking into the eyes of a cow: Can eye whites be used as a measure of emotional state? Applied Animal Behaviour Science 186, 1–6. https://doi.org/10.1016/j.applanim.2016.11.005

Lambooij, E., van der Werf, J.T.N., Reimert, H.G.M., Hindle, V.A., 2012. Compartment height in cattle transport vehicles. Livestock Science 148, 87–94. https://doi.org/10.1016/J.LIVSCI.2012.05.014

Langkabel, N., Baumann, M.P.O., Feiler, A., Sanguankiat, A., Fries, R., 2015. Influence of two catching methods on the occurrence of lesions in broilers. Poultry Science 94, 1735–1741. https://doi.org/10.3382/ps/pev164

Lippmann, J., Schäffer, D., Laube, R., 1999. Noise at Slaughter Plants-Behavioural Adaptation of Slaughter Pigs to Different Noise Situations. KTBL SCHRIFT 181–188.

Llonch, P., King, E.M., Clarke, K.A., Downes, J.M., Green, L.E., 2015. A systematic review of animal based indicators of sheep welfare on farm, at market and during transport, and qualitative appraisal of their validity and feasibility for use in UK abattoirs. Veterinary Journal 206, 289–297. https://doi.org/10.1016/j.tvjl.2015.10.019

Losada-Espinosa, N., Villarroel, M., María, G.A., Miranda-de la Lama, G.C., 2018. Pre-slaughter cattle welfare indicators for use in commercial abattoirs with voluntary monitoring systems: A systematic review. Meat Science 138, 34–48. https://doi.org/10.1016/j.meatsci.2017.12.004

Malena, M., Voslářová, E., Kozák, A., Bělobrádek, P., Bedáňová, I., Steinhauser, L., Večerek, V., 2007. Comparison of Mortality Rates in Different Categories of Pigs and Cattle during Transport for Slaughter. Acta Veterinaria Brno 76, 109–116. https://doi.org/10.2754/AVB200776S8S109

Marcato, F., van den Brand, H., Kemp, B., Engel, B., Schnabel, S.K., Hoorweg, F.A., Wolthuis-Fillerup, M., van Reenen, K., 2022a. Effects of transport age and calf and maternal characteristics on health and performance of veal calves. Journal of Dairy Science 105, 1452–1468.

https://doi.org/10.3168/JDS.2021-20637

Marcato, F., van den Brand, H., Kemp, B., Engel, B., Schnabel, S.K., Jansen, C.A., Rutten, V.P.M.G., Koets, A.P., Hoorweg, F.A., de Vries-Reilingh, G., Wulansari, A., Wolthuis-Fillerup, M., van Reenen, K., 2022b. Calf and dam characteristics and calf transport age affect immunoglobulin titers and hematological parameters of veal calves. Journal of Dairy Science 105, 1432–1451. https://doi.org/10.3168/JDS.2021-20636

Marchant-Forde, J.N., Marchant-Forde, R.M., 2008. Welfare of pigs during stunning and slaughter, in: Welfare of Pigs from Birth to Slaughter. pp. 225–242. https://doi.org/10.3920/978-90-8686-637-3

Marino, B.L., Colvin, C.M., 2015. Thinking Pigs : an Exploration of the Cognitive Complexity of. International Journal of Comparative Psychology 28.

Marino, L., 2017. Thinking chickens: a review of cognition, emotion, and behavior in the domestic chicken. Animal Cognition. https://doi.org/10.1007/s10071-016-1064-4

Marino, L., Allen, K., 2017. The psychology of cows. Animal Behavior and Cognition 4, 474–498. https://doi.org/10.26451/abc.04.04.06.2017

Marino, L., Merskin, D., 2019. Intelligence, complexity, and individuality in sheep. Animal Sentience 4. https://doi.org/10.51291/2377-7478.1374

McGlone, J., Sapkota, A., Johnson, A., Animals, R.K.-, 2014, undefined, 2014. Establishing trailer ventilation (boarding) requirements for finishing pigs during transport. mdpi.com 4, 515–523. https://doi.org/10.3390/ani4030515

Mcglone, J.J., Mcpherson, R.L., Anderson, D.L., 2004. Moving Devices for Finishing Pigs: Efficacy of Electric Prod, Board, Paddle, or Flag. Professional Animal Scientist 20, 518–523. https://doi.org/10.15232/S1080-7446(15)31357-7

McLennan, K.M., Rebelo, C.J.B., Corke, M.J., Holmes, M.A., Leach, M.C., Constantino-Casas, F., 2016. Development of a facial expression scale using footrot and mastitis as models of pain in sheep. Applied Animal Behaviour Science 176, 19–26. https://doi.org/10.1016/j.applanim.2016.01.007

Meléndez, D.M., Marti, S., Haley, D.B., Schwinghamer, T.D., Schwartzkopf-Genswein, K.S., 2020. Effect of transport and rest stop duration on the welfare of conditioned cattle transported by road. PLoS ONE 15, 1–22. https://doi.org/10.1371/journal.pone.0228492

Messori, S., Pedernera-Romano, C., Magnani, D., Rodriguez, P., Barnard, S., Dalmau, A., Velarde, A., Dalla Villa, P., 2015. Unloading or not unloading? Sheep welfare implication of rest stop at control post after a 29h transport. Small Ruminant Research 130, 221–228. https://doi.org/10.1016/j.smallrumres.2015.07.012

Miranda-de la Lama, G.C., Monge, P., Villarroel, M., Olleta, J.L., García-Belenguer, S., María, G.A., 2011. Effects of road type during transport on lamb welfare and meat quality in dry hot climates. Tropical Animal Health and Production 43, 915–922. https://doi.org/10.1007/s11250-011-9783-7

Miranda-de la Lama, G.C., Rivero, L., Chacón, G., Garcia-Belenguer, S., Villarroel, M., Maria, G.A., 2010. Effect of the pre-slaughter logistic chain on some indicators of welfare in lambs. Livestock Science 128, 52–59. https://doi.org/10.1016/j.livsci.2009.10.013

Mitchell, M.A., Kettlewell, P.J., 2008. Engineering and design of vehicles for long distance road transport of livestock (ruminants, pigs and poultry). Vet Ital 44, 201–13.

Mönch, J., Rauch, E., Hartmannsgruber, S., Erhard, M., Wolff, I., Schmidt, P., Schug, A.R., Louton, H., 2020. The welfare impacts of mechanical and manual broiler catching and of circumstances at loading under field conditions. Poultry Science 99, 5233–5251. https://doi.org/10.1016/j.psj.2020.08.030

Neave, H.W., Daros, R.R., Costa, J.H.C.C., Von Keyserlingk, M.A.G.G., Weary, D.M., 2013. Pain and pessimism: dairy calves exhibit negative judgement bias following hot-iron disbudding. PLoS One 8, e80556. https://doi.org/10.1371/journal.pone.0080556

Nielsen, B.L., Dybkjr, L., Herskin, M.S., 2011. Road transport of farm animals: Effects of journey duration on animal welfare. Animal 5, 415–427. https://doi.org/10.1017/S1751731110001989

Odore, R., D'Angelo, A., Badino, P., Bellino, C., Pagliasso, S., Re, G., 2004. Road transportation affects blood hormone levels and lymphocyte glucocorticoid and β-adrenergic receptor concentrations in calves. The Veterinary Journal 168, 297–303. https://doi.org/10.1016/J.TVJL.2003.09.008

Parker, C.D., 2018. Welfare of poultry during transport. Veterinary Record 183, 420. https://doi.org/10.1136/vr.k4145

Parrott, R.F., Hall, S.J.G., Lloyd, D.M., 1998. Heart rate and stress hormone responses of sheep to road transport following two different loading procedures. Animal Welfare 7, 257–267.

Pascual-Alonso, M., Miranda-de la Lama, G.C., Aguayo-Ulloa, L., Villarroel, M., Mitchell, M., María, G.A., 2017. Thermophysiological, haematological, biochemical and behavioural stress responses of sheep transported on road. Journal of Animal Physiology and Animal Nutrition 101, 541–551. https://doi.org/10.1111/jpn.12455

Peeters, E., Deprez, K., Beckers, F., De Baerdemaeker, J., Auben, A.E., Geers, R., 2008. Effect of driver and driving style on the stress responses of pigs during a short journey by trailer. Animal Welfare 17, 189–196.

Pilecco, M., Almeida Paz, I.C.L., Tabaldi, L.A., Nääs, I.A., Garcia, R.G., Caldara, F.R., Francisco, N.S., 2013. Training of catching teams and reduction of back scratches in broilers. Revista Brasileira de Ciencia Avicola 15, 283–286. https://doi.org/10.1590/S1516-635X2013000300017

Proctor, H.S., 2012. Animal Sentience: Where Are We and Where Are We Heading? Animals 2, 628–639. https://doi.org/10.3390/ani2040628

Proctor, H.S., Carder, G., 2016. Can changes in nasal temperature be used as an indicator of emotional state in cows? Applied Animal Behaviour Science 184, 1–6. https://doi.org/10.1016/j.applanim.2016.07.013

Proctor, H.S., Carder, G., 2014. Can ear postures reliably measure the positive emotional state of cows? Applied Animal Behaviour Science 161, 20–27. https://doi.org/10.1016/j.applanim.2014.09.015

Proctor, H.S., Carder, G., Cornish, A., 2013. Searching for Animal Sentience: A Systematic Review of the Scientific Literature. Animals 3, 882–906. https://doi.org/10.3390/ani3030882

Queiroz, M.L. de V., Barbosa Filho, J.A.D., Duarte, L.M., De Brasil, D.F., Gadelha, C.R.F., 2015. Environmental and physiological variables during the catching of broilers. Revista Brasileira de Ciencia Avicola 17, 37–44. https://doi.org/10.1590/1516-635x170137-44

Reefmann, N., Kaszàs, F., Wechsler, B., Gygax, L., 2009a. Ear and tail postures as indicators of emotional valence in sheep. Applied Animal Behaviour Science 118, 199–207.

Reefmann, N., Wechsler, B., Gygax, L., 2009b. Behavioural and physiological assessment of positive and negative emotion in sheep. Animal Behaviour 78, 651–659. https://doi.org/10.1016/j.anbehav.2009.06.015

Reimert, I., Fong, S., Rodenburg, T.B., Bolhuis, J.E., 2017. Emotional states and emotional contagion in pigs after exposure to a positive and negative treatment. Applied Animal Behaviour Science 193, 37–42. https://doi.org/10.1016/j.applanim.2017.03.009

Richards, G.J., Wilkins, L.J., Weeks, C.A., Knowles, T.G., Brown, S.N., 2012. Evaluation of the microclimate in poultry transport module drawers during the marketing process of end-of-lay hens from farm to slaughter. Veterinary Record 171, 474. https://doi.org/10.1136/vr.100844

Ritter, M.J., Ellis, M., Anderson, D.B., Curtis, S.E., Keffaber, K.K., Killefer, J., McKeith, F.K., Murphy, C.M., Peterson, B.A., 2009. Effects of multiple concurrent stressors on rectal temperature, blood acid-base status, and longissimus muscle glycolytic potential in market-weight pigs. Journal of Animal Science 87, 351–362. https://doi.org/10.2527/jas.2008-0874

Ritter, M.J., Ellis, M., Bowman, R., Brinkmann, J., Curtis, S.E., DeDecker, J.M., Mendoza, O., Murphy, C.M., Orellana, D.G., Peterson, B.A., Rojo, A., Schlipf, J.M., Wolter, B.F., 2008. Effects of season and distance moved during loading on transport losses of market-weight pigs in two commercially n available types of trailer. Journal of Animal Science 86, 3137–3145. https://doi.org/10.2527/jas.2008-0873

Roadknight, N., Mansell, P., Jongman, E., Courtman, N., Fisher, A., 2021. Invited review: The welfare of young calves transported by road. Journal of Dairy Science 104, 6343–6357. https://doi.org/10.3168/jds.2020-19346

Rocha, L.M., Velarde, A., Dalmau, A., Saucier, L., Faucitano, L., 2016. Can the monitoring of animal welfare parameters predict pork meat quality variation through the supply chain (From farm to slaughter)? Journal of Animal Science 94, 359–376. https://doi.org/10.2527/jas.2015-9176

Rodriguez-Navarro, A.B., McCormack, H.M., Fleming, R.H., Alvarez-Lloret, P., Romero-Pastor, J., Dominguez-Gasca, N., Prozorov, T., Dunn, I.C., 2018. Influence of physical activity on tibial bone material properties in laying hens. Journal of Structural Biology 201, 36–45. https://doi.org/10.1016/J.JSB.2017.10.011

Ross, M., Rausch, Q., Vandenberg, B., Mason, G., 2020. Hens with benefits: Can environmental enrichment make chickens more resilient to stress? Physiology & Behavior 226, 113077. https://doi.org/10.1016/J.PHYSBEH.2020.113077

Saraiva, S., Esteves, A., Oliveira, I., Mitchell, M., Stilwell, G., 2020. Impact of pre-slaughter factors on welfare of broilers. Veterinary and Animal Science 10, 100146. https://doi.org/10.1016/j.vas.2020.100146

Schuetze, S.J., Schwandt, E.F., Maghirang, R.G., Thomson, D.U., 2017. REVIEW: Transportation of commercial finished cattle and animal welfare considerations. Professional Animal Scientist. https://doi.org/10.15232/pas.2017-01620

Schwartzkopf-Genswein, K., Ahola, J., Edwards-Callaway, L., Hale, D., Paterson, J., 2016. SYMPOSIUM PAPER: Transportation issues affecting cattle well-being and considerations for the future. Professional Animal Scientist 32, 707–716. https://doi.org/10.15232/pas.2016-01517

Schwartzkopf-Genswein, K.S., Faucitano, L., Dadgar, S., Shand, P., González, L.A., Crowe, T.G., 2012. Road transport of cattle, swine and poultry in North America and its impact on animal welfare, carcass and meat quality: A review. Meat Science 92, 227–243. https://doi.org/10.1016/j.meatsci.2012.04.010

Simon, G.E., Hoar, B.R., Tucker, C.B., 2016. Assessing cow-calf welfare. Part 2: Risk factors for beef cow health and behavior and stockperson handling. Journal of Animal Science 94, 3488–3500. https://doi.org/10.2527/JAS.2016-0309

Sommavilla, R., Faucitano, L., Gonyou, H., Seddon, Y., Bergeron, R., Widowski, T., Crowe, T., Connor, L., Scheeren, M.B., Goumon, S., Brown, J., 2017. Season, transport duration and trailer compartment effects on blood stress indicators in pigs: Relationship to environmental, behavioral and other physiological factors, and pork quality traits. Animals 7, 1–12. https://doi.org/10.3390/ani7020008

Stockman, C.A., Collins, T., Barnes, A.L., Miller, D., Wickham, S.L., Beatty, D.T., Blache, D., Wemelsfelder, F., Fleming, P.A., 2013. Flooring and driving conditions during road transport influence the behavioural expression of cattle. Applied Animal Behaviour Science 143, 18–30. https://doi.org/10.1016/j.applanim.2012.11.003

Strappini, A.C., Frankena, K., Metz, J.H.M., Gallo, B., Kemp, B., 2010. Prevalence and risk factors for bruises in Chilean bovine carcasses. Meat Science 86, 859–864. https://doi.org/10.1016/J.MEATSCI.2010.07.010

Strappini, A.C., Metz, J.H.M., Gallo, C., Frankena, K., Vargas, R., De Freslon, I., Kemp, B., 2013. Bruises in culled cows: when, where and how are they inflicted? Animal 7, 485–491. https://doi.org/10.1017/S1751731112001863

Sutherland, M.A., McDonald, A., McGlone, J.J., 2009. Effects of variations in the environment, length of journey and type of trailer on the mortality and morbidity of pigs being transported to slaughter. Veterinary Record 165, 13–18. https://doi.org/10.1136/vetrec.165.1.13

Taling, J.C., Lines, J.A., Wathes, C.M., Waran, N.K., 1998. The acoustic environment of the domestic pig. Journal of Agricultural and Engineering Research 71, 1–12. https://doi.org/10.1006/jaer.1998.0291

Talling, J.C., Waran, N.K., Wathes, C.M., Lines, J.A., 1998. Sound avoidance by domestic pigs depends upon characteristics of the signal. Applied Animal Behaviour Science 58, 255–266. https://doi.org/10.1016/S0168-1591(97)00142-1

Talling, J.C., Waran, N.K., Wathes, C.M., Lines, J.A., 1996. Behavioural and physiological responses of pigs to sound. Applied Animal Behaviour Science 48, 187–201. https://doi.org/10.1016/0168-1591(96)01029-5

Valkova, L., Vecerek, V., Voslarova, E., Kaluza, M., Takacova, D., 2021a. The welfare of cattle, sheep, goats and pigs from the perspective of traumatic injuries detected at slaughterhouse postmortem inspection. Animals 11, 1–14. https://doi.org/10.3390/ani11051406

Valkova, L., Voslarova, E., Vecerek, V., Dolezelova, P., Zavrelova, V., Weeks, C., 2021b. Traumatic Injuries Detected during Post-Mortem Inspections in Poultry and Rabbits. Animals 11, 1–11.

Vecerek, V., Grbalova, S., Voslarova, E., Janackova, B., Malena, M., 2006. Effects of travel distance and the season of the year on death rates of broilers transported to poultry processing plants. Poultry Science 85, 1881–1884. https://doi.org/10.1093/ps/85.11.1881

Vecerek, V., Voslarova, E., Conte, F., Vecerkova, L., Bedanova, I., 2016. Negative trends in transport-related mortality rates in broiler chickens. Asian-Australasian Journal of Animal Sciences 29, 1796–1804. https://doi.org/10.5713/ajas.15.0996

Vecerkova, L., Vecerek, V., Voslarova, E., 2019. Welfare of end-of-lay hens transported for slaughter: effects of ambient temperature, season, and transport distance on transport-related mortality. Poultry Science 98, 6217–6224. https://doi.org/10.3382/ps/pez468

Verbeek, E., Ferguson, D., Lee, C., 2014. Are hungry sheep more pessimistic? The effects of food restriction on cognitive bias and the involvement of ghrelin in its regulation. Physiology and Behavior 123, 67–75. https://doi.org/10.1016/j.physbeh.2013.09.017

Vermeulen, L., Van de Perre, V., Permentier, L., De Bie, S., Verbeke, G., Geers, R., 2016. Pre-slaughter sound levels and pre-slaughter handling from loading at the farm till slaughter influence pork quality. Meat Science 116, 86–90. https://doi.org/10.1016/j.meatsci.2016.02.007

Voslarova, E., Chloupek, P., Vosmerova, P., Chloupek, J., Bedanova, I., Vecerek, V., 2011. Time course changes in selected biochemical indices of broilers in response to pretransport handling. Poultry Science 90, 2144–2152. https://doi.org/10.3382/PS.2011-01473

Voslarova, E., Vecerek, V., Passantino, A., Chloupek, P., Bedanova, I., 2017. Transport losses in finisher pigs: Impact of transport distance and season of the year. Asian-Australasian Journal of Animal Sciences 30, 119–124. https://doi.org/10.5713/ajas.16.0265

Waiblinger, S., Menke, C., Korff, J., Bucher, a, 2004. Previous handling and gentle interactions affect behaviour and heart rate of dairy cows during a veterinary procedure. Applied Animal Behaviour Science 85, 31–42. https://doi.org/10.1016/j.applanim.2003.07.002

Weary, D.M., Niel, L., Flower, F.C., Fraser, D., 2006. Identifying and preventing pain in animals. Applied Animal Behaviour Science 100, 64–76. https://doi.org/10.1016/j.applanim.2006.04.013

Weeks, C.A., Brown, S.N., Richards, G.J., Wilkins, L.J., Knowles, T.G., 2012. Levels of mortality in hens by end of lay on farm and in transit to slaughter in Great Britain. Veterinary Record 170, 647. https://doi.org/10.1136/vr.100728

Weschenfelder, A. V., Torrey, S., Devillers, N., Crowe, T., Bassols, A., Saco, Y., Piñeiro, M., Saucier, L., Faucitano, L., 2012. Effects of trailer design on animal welfare parameters and carcass and meat quality of three Pietrain crosses being transported over a long distance. Journal of Animal Science 90, 3220–3231. https://doi.org/10.2527/JAS.2012-4676

Westerath, H.S., Gygax, L., Hillmann, E., 2014. Are special feed and being brushed judged as positive by calves? Applied Animal Behaviour Science 156, 12–21. https://doi.org/10.1016/j.applanim.2014.04.003

White, B., Blasi, D., Vogel, L., science, M.E.-J. of animal, 2009, undefined, 2009. Associations of beef calf wellness and body weight gain with internal location in a truck during transportation. academic.oup.com 87, 4143–4150. https://doi.org/10.2527/jas.2009-2069

Whiting, T.L., 2016. Pain in human and non-human animals caused by electricity. The Canadian Veterinary Journal 57, 883.

Wickham, S.L., Collins, T., Barnes, A.L., Miller, D.W., Beatty, D.T., Stockman, C., Blache, D., Wemelsfelder, F., Fleming, P.A., 2012. Qualitative behavioral assessment of transport-naïve and transport-habituated sheep. Journal of Animal Science 90, 4523–4535. https://doi.org/10.2527/jas.2010-3451

Wilhelmsson, S., 2022. There's no time to rush!: pigs' and transport drivers' welfare and interactions during slaughter transport. Swedish University of Agricultural Sciences. https://doi.org/10.2307/j.ctt2005rgq.7

Yardimci, M., Sahin, E.H., Cetingul, I.S., Bayram, I., Aslan, R., Sengor, E., 2013. Stress responses to comparative handling procedures in sheep. Animal 7, 143–150. https://doi.org/10.1017/S1751731112001449

Picture Credits

Tom Woolard: 5, 9, 10, 12, 13, 21, 28, 41, 42, 43, 44, 47
Dale Phelan: 4, 16, 19, 29, 48

ANIMAL JUSTICE PROJECT
witness • expose • react

Animal Justice Project, 27 Old Gloucester Street, London, WC1N 3AX, UK
Registered Company Number: 09335745 | Charity Trust Number: 1184965
animaljusticeproject.com | info@animaljusticeproject.com