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Antemortem Exploration of the Effect of Human Behavior on Beef Carcass Bruising

Abstract

The ability of beef producers and processors to experience profit is largely reliant on a quality product free of blemish, bruise, and excessive trim loss. Carcass bruising is a contributor to this loss of saleable product, and can be attributed to a multitude of animal, human, and facility-related factors. This study examined beef carcass bruising throughout pre-harvest handling through physical observation of trailer unloading, handling within processing areas, and evaluation of facilities to determine whether a plant was deemed conducive to proper animal handling. The theory of planned behavior served as the conceptual foundation, wherein the components of attitude, subjective norms, and perceived behavioral control were explored through observation of pre-harvest handling and researcher administered questionnaires. Observation revealed that the elements of facility design, forceful unloading and cattle slips and falls were most likely to contribute to events associated with carcass bruising, and that outward pressures were also a factor in the behavioral component of handlers.

Introduction

Carcass bruises in fed cattle have been a topic of concern for producers, packers and everyday consumers alike since the issue was discussed during the second National Beef Quality Audit in 1995. Subsequent audits illustrated a fluctuation of carcass bruising across all industry segments, i.e., fed cattle or market cow and bull, which reinforced the underlying concern that the problem was not confined to a single sector, but instead fell under the responsibility of all members of the beef industry.

The aspect of human behavior, in the context of animal handling, is largely dependent on the behavioral intentions of the individual (Ajzen, 1985, 1991). Those behaviors that produce negative impacts on animal welfare and the animal product itself are noted with apprehension, as they pose a threat to the economic viability and public perception of beef and animal products (Grandin, 1980; Huertas et al., 2015; Lee, 2017). Implications that result from improper handler behavior are generally indicative of poor animal welfare.

The implications of bruised carcasses are felt throughout the U.S. beef industry in the form of annual losses that climb into the millions (Lee, 2017). Bruising, as defined by Huertas et al. (2015) is the result of tissue damage characterized by vascular rupture and the collection of blood and blood serum. As they negatively affect meat quality and value, bruises must be trimmed from the carcass and ultimately discarded. Depending on bruise severity, the extent to which they impact economic viability varies. These blemishes become most detrimental when found on the loin, ribs, chuck or hindquarters, as these are the most valuable cuts of the carcass (Garcia et al., 2008). Past quality audits have determined that concentrated bruising in these locations are often indicative of improper pre-harvest handling or loading and unloading during transport from the auction to the harvesting facility. Correlational studies examining the relationship between handling, travel, and unloading procedures reinforce this observation and conclude that there is a strong association between the quality of animal treatment in each of these stages and the end result of carcass bruising and economic loss (Hoffman et al., 1998).

Based on the economic, quality, and welfare implications associated with beef carcass bruising, this study explores the impact of human involvement in the process by revealing the behavioral intent and reasoning behind the actions that ultimately lead to carcass injury. Data collected through this study offer insight to the question of how human behavior impacts the rate of carcass bruising in beef cattle. On an industry-wide scale, the information presented may assist the U.S. beef industry in reducing the incidence of carcass bruising, reducing economic losses, and improving the relationship and understanding of human behavior in relation to an animal's experience during processing.

Methods

Observations and questionnaires were conducted at four small and very small beef processing facilities throughout Ohio. The designation of small or very small is determined by the Department of Agriculture's Food Safety and Inspection Service (FSIS), wherein a small establishment has between 10 and 500 employees, and a very small establishment has less than 10 employees (Federal Register, 1996). Eight handlers were observed using a checklist data collection tool, and five handlers were administered an oral questionnaire.

Structured observations – checklist

Structured observation served as the first mode of data collection. A checklist, categorized by facility structure and efficiency, unloading processes, human behaviors, cattle activity, and human/animal interaction provided a guide with which to observe antemortem interactions. Each category included a subset of questions to document specific behaviors, handling practices, facility environment, and the number of occurrences of each. Facilities and equipment were evaluated for cleanliness, drainage, presence of non-slip flooring, adequate lighting and their overall contribution to the calm and efficient movement of cattle. The unloading areas, holding pens, and chutes were the primary foci of the evaluation, but additional aspects such as back-gates and size of equipment were included as well if applicable. Trailer unloading was also documented

through a series of questions centered around the cattle and human interaction during the process. Noted were data pertaining to whether cattle exit the trailer with forceful human assistance or on their own, encounter trailer doors or gates, are allowed to walk through the facility at a natural pace or are pushed to move at a fast pace, or obtain any outward injuries as a result of their handling experience.

Evaluation of human handling took place at multiple points throughout processing, including unloading cattle from the trailer, moving cattle to holding pens, transporting from pens to chutes, and finally transporting from the chute to the stunning area. Guiding observational notes prompted researchers to note whether the handlers allowed cattle to maintain a walking pace, behaved aggressively towards animals through physical action or use of hotshots or handling equipment, worked cohesively with fellow handlers, or altered their behavior because of the actions of others. Time of day was recorded upon arrival of the trailer, unloading of all cattle from the trailer, and at the completion of moving all cattle to a holding pen. To establish consistency, the same checklist and guiding questions were utilized at each plant observation.

Researcher administered questionnaire

Following observation and the completion of the unloading process, face-to-face questionnaire-guided interviews were conducted with participants who were routinely involved in the unloading and pre-harvest handling process. The questionnaire addressed specific aspects of their role in the processing and handling of cattle, including their attitude and perceived level of importance regarding their job and its' impact on carcass quality.

Results

Analysis of facilities and equipment

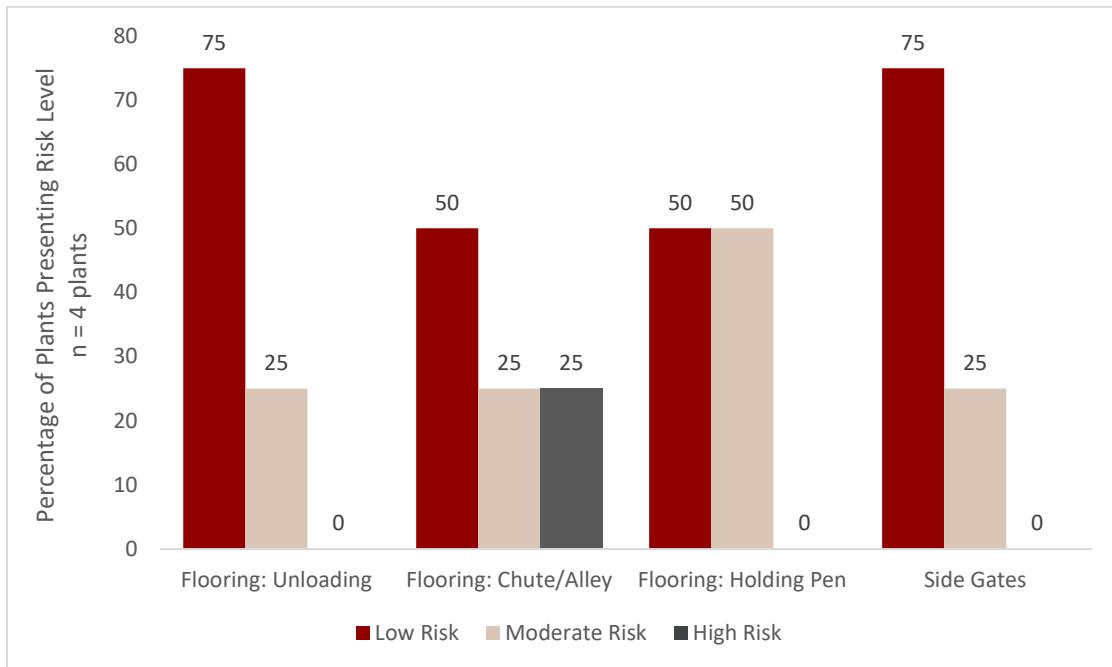


Figure 1. Notable risk factors present during facility and equipment observations

Analysis of unloading procedures

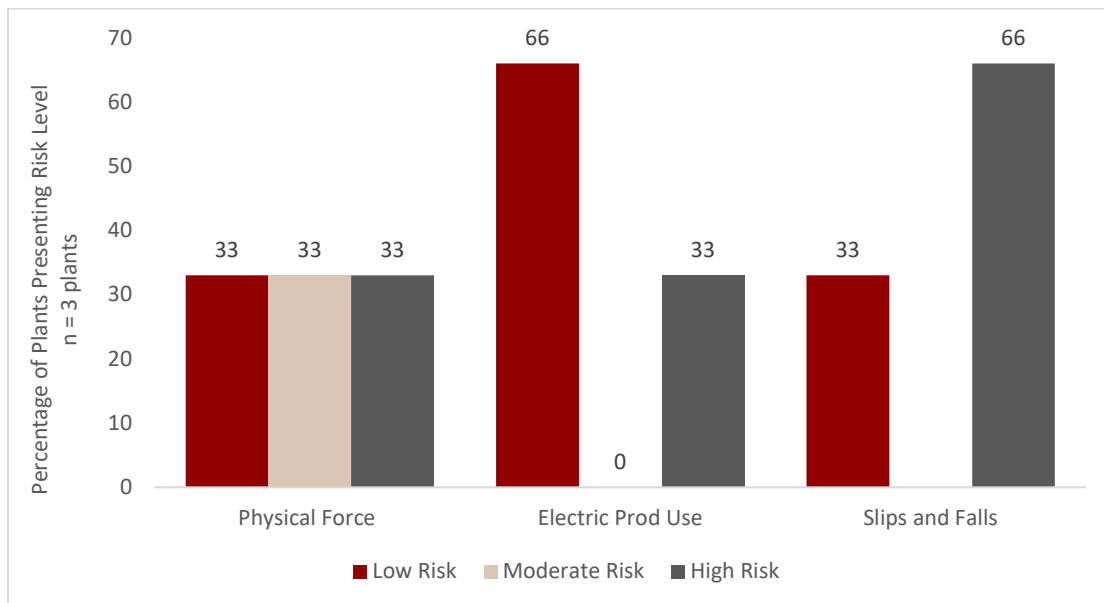


Figure 2. Notable risk factors present during unloading observations

Analysis of handlers

Handlers employed by the processing plants assessed were observed for a variety of behaviors, including speed, attitude, use of equipment and calmness while processing cattle. Pace, calmness level, and vocal cues of handlers were categorized as low risk across all observations. Use of electric prods was categorized as moderate risk (less than 25%), as a single handler used the equipment twice. Awareness of cattle flight zones held steady in the low-risk category throughout observations, and the proper use of points of balance and cattle instincts contributed low risk to carcass bruising.

Analysis of cattle

Aspects of cattle observed throughout the handling process included vocalization, balking, falling, forceful contact with equipment, and visible injuries obtained throughout processing. Using the measures set forth in the 2019 audit guide, cattle slips and falls were recorded as low risk during 25% of observations and high-risk during 75% of observations. Forceful contact with foreign objects or handling equipment presented a low risk for bruising, however contact with holding pen gates contributed moderate risk. Visible injury in the form of cuts or tears in the hide was observed at two of the selected processing plants and suggested moderate risk for bruising at 25%.

Researcher administered questionnaires

Questions posed through the questionnaire addressed participant attitudes toward their role as animal handlers, subjective norms affiliated with their position, and their perceived behavioral control over their surroundings and resulting carcass quality in their capacity as an animal handler. Responses were categorized on a five-point Likert-type scale where:

- 1 = *strongly disagree*,
- 2 = *disagree*,
- 3 = *neither agree nor disagree*,
- 4 = *agree*, and
- 5 = *strongly agree*.

Question	Frequency of agreement/disagreement					M	SD
	SD	D	NAND	A	SA		
	F(%)	F(%)	F(%)	F(%)	F(%)		
Attitude							
Describe your background in agriculture or working with cattle.	0(0)	0(0)	0(0)	3(60)	2(40)	4.40	0.55
Describe how you believe carcass bruising impacts profitability.	0(0)	0(0)	0(0)	4(80)	1(20)	4.20	0.45
Describe how operations at your plant have been affected by COVID-19.	0(0)	1(20)	1(20)	3(60)	0(0)	3.40	0.89
Subjective Norms							
Describe how your company promotes/values animal handling.	0(0)	0(0)	0(0)	5(100)	0(0)	4.00	0.00
Describe how your coworkers demonstrate animal handling.	0(0)	0(0)	1(20)	4(80)	0(0)	3.80	0.45
Describe how the demand for more locally processed beef has impacted your role.	0(0)	2(40)	1(20)	2(40)	0(0)	3.00	1.00
How do you feel COVID-19 has affected workplace stress?	1(20)	4(80)	0(0)	0(0)	0(0)	1.80	0.44

Perceived Behavioral Control							
Describe the type of training that you completed to work here.	0(0)	4(80)	1(20)	0(0)	0(0)	2.20	0.45
Describe how you see your role in animal handling affecting the overall quality of the beef processed here.	0(0)	3(60)	0(0)	2(40)	0(0)	2.80	1.10
Describe how coworkers handling methods impact the way you handle cattle.	0(0)	2(40)	2(40)	1(20)	0(0)	2.80	0.84
Describe how the equipment and the design of this facility benefits or hinders your ability to handle cattle safely and properly.	1(20)	3(60)	0(0)	0(0)	1(20)	2.40	1.52
Scale: SD = Strongly Disagree, D = Disagree, NAND = Neither Agree nor Disagree, A = Agree, SA = Strongly Agree							

Figure 3. Descriptive analysis of interview questions

Discussion

Results drawn from the observation and questionnaire indicated that handler behavior during the pre-harvest handling of beef cattle is complex and dependent upon multiple internal and external factors. The most common behaviors observed during this study that resulted in actions linked to bruising were excessive use of electric prods, physical force, and forcing movement at a faster than natural pace. Prod use was recorded as a high-risk behavior during 33% of observations and was primarily due to the hauler attempting to increase the pace of the unloading process.

Occurrence of cattle slips and falls fell largely into the high-risk category; however, this event was not singularly tied to aggressive handling. The lack of textured or grooved

flooring compounded this issue when cattle unloaded the trailer with wet hooves or tracked water, urine, or manure throughout the chutes and working areas, which produced a slippery surface for both cattle and human handlers alike.

In addition to the physical data, verbal information collected during questionnaires provided insight into the components of behavior related to intent and outward action. Attitudes were largely positive with regards to personal background, experience, and feelings toward bruising's impact on profitability. On the other end of the spectrum, disagreement and negative attitudes were exhibited when asked about the effect of facilities and design on one's ability to effectively handle cattle, and feelings were generally positive regarding perception of their role and how coworkers demonstrated handling themselves.

This suggests that handlers place value on their personal experience and understand that bruising affects the bottom line, but their opinion of existing working facilities did not bolster a positive attitude all around. These attitudes toward facilities were evident when handlers became briefly and visibly frustrated with a piece of equipment, such as a gate or chute, or flooring when its ineffectiveness slowed progress or made proper processing more challenging. In these cases, the inward attitude of the handler was often indicative of their outward behaviors, and negative outward behavior was more common when risk factors were present.

When the hauler was present and interactive during the unloading process, this also influenced the attitude of the handler. Calm, non-aggressive behavior on the part of the hauler resulted in the continuation of positive body language and behavior on the part of the handler. However, when the hauler demonstrated more high-risk behaviors, such as physical force, rushing cattle, or excessively using an electric prod, the handler was more apt to become frustrated or exhibit negative behavioral cues and attitudes, therefore increasing the instances of moderate to high-risk behaviors observed.

In reference to their role in animal handling and its effect on beef quality, multiple participants expressed that while they did believe that their role had the ability to make an impact, they felt as though the roles of the primary producer and hauler held more

stock in the ultimate end product. Mixed feelings were recorded regarding the influence of coworkers on an individual's ability to control the outcomes of their handling, yet responses were mostly negative regarding the impact of facilities and equipment on their ability to correctly do their jobs. A common sentiment among participants was that there was only so much within their control regarding their physical working conditions.

Due to the unique timing of this study, questions concerning the coronavirus pandemic and its influence on the day-to-day operations of small packing plants were also included. Handlers tended to view the uptick in demand as a positive outcome, as it nullified any job security concerns, and it signaled a newfound interest by consumers in purchasing locally raised beef. However, this "good" problem may have also created an increase in stress levels stemming from heightened expectations, the need to process cattle faster than normal, and the looming uncertainty regarding personal health and ability to maintain the current pace. These factors aided in the development of a working environment that was unfamiliar to all participants, and the resulting effects on attitude and the accompanying components of behavior should be considered in future studies.

Implications

It is evident through the provided data that a company can be aware and supportive of correct animal handling practices without realizing that their own facility inhibits completion in a physical and behavioral sense. To work towards removing those physical barriers and more thoroughly understanding the 'why' behind the behavior of handlers, recommendations stemming from data collected throughout this study should be implemented. The initial phase of this study revealed through observation that facilities can play a substantial role in the success of handler efforts to process cattle properly. While many participants felt as though their employer valued and promoted the industry standards surrounding handling, they often expressed the hindrances caused by the design or condition of the facility in which they worked.

Results from this study also indicate that the level of training required or provided to handlers affects handler understanding of the beliefs and expectations placed on their position. Most respondents in this study received no formal training, and instead learned via on-the-job experience. While this does provide the opportunity for experiential

learning, the addition of a more formal training or continued education opportunity such as BQA may more effectively signal the company's stance on handling and generate a clearer vision of the beliefs and expectations placed on handlers. Among handlers that had completed formal beef quality and animal handling training for prior positions, a more thorough understanding of the goals of their position was noted.

Within university-led departments such as Extension, the findings of this study signal an opportunity for education and outreach to local beef processing plants. For an Extension professional, simply starting with a facility/equipment evaluation could aid in cultivating a relationship with the plant employees and manager and could aid in the development of recommendations to improve plant efficiency and animal handling practices. In the aspect of training, it is important for Extension professionals to remember that processing plant clientele and haulers should be included in programs, such as BQA or handling clinics, alongside beef and dairy producers alike. This will sometimes require more intentional outreach but will likely yield positive results.

Conclusions

Implications of this study are impactful and actionable on various levels, ranging from the individual producer, the packing plant or processor, industry, and ultimately academically related institutions such as Extension. As mentioned within the implications of this study, the data indicated that processing plants can be fully aware and supportive of correct animal handling and bruising preventative measures, however their own facilities and training methods may not allow for proper follow-through. On the processor level, the data implies that evaluation of flooring in the unloading, chute, and holding pen areas for non-slip texture and drainage to prevent wet, slick surfaces, along with chute and pen design to allow handlers to move cattle according to their instinctual behaviors, is needed. While adjusting and re-evaluating facility design or equipment placement may require added physical and financial resources, meeting the needs of handlers to process cattle properly could improve attitudes, perceived behavioral control, and minimize behavior that results in carcass bruising.

Beyond facility structure and evaluation, training, whether it was required prior to hiring, or was intended to be fulfilled on-the-job, was a determinant in shaping the handler's understanding of the expectations placed on their position. As the data suggests, the addition of formal training or continued education would present the opportunity for company managers to ensure a handler's understanding of the impact that aggressive or rough handling can have on carcass quality, and ultimately company profitability. Training alone, however, can be more impactful when coupled with the recurring presence of a manager, owner, or humane handling inspector during ante-mortem handling or unloading. Physical involvement with the process demonstrates dedication to correct handling and can help handlers and employees to become more actively aware and cognizant of their handling techniques and behavior, while maintaining an open line of communication with their supervisors.

On a broader industry level, the expansion of existing beef quality and handling programs should be pursued and made more accessible to both company managers and handlers. In addition to in-person and online BQA formats, there are many online and downloadable instructional videos and trainings offered through university and industry professionals nationwide. Nonetheless, without a working knowledge of the locations of these trainings, it may prove challenging to find and offer them to employees. Further research would be needed to definitively speak to the accessibility of these resources, however processors and those involved in the processing industry may benefit from a strategic and unified effort to prioritize handling and understanding how human and animal behaviors interact during processing.

For Extension professionals, the data suggest a need for increased outreach and educational opportunities tailored toward local processors. Initial outreach can be as simple as gaining permission to tour the facilities, while observing the unloading docks and handling areas on a kill day, followed by a discussion with plant managers and employees regarding recommendations and efficiency points related to the evaluation. With many areas still experiencing heightened interest in direct market or local beef following the Covid-19 pandemic, some processors may benefit greatly from this type of evaluation as they look to either expand processing capacity or update facility design.

As many Extension professionals also serve as instructors either through BQA or related livestock handling training programs, it is important to include processors and haulers, as their role holds significant impact on beef quality. If there is enough interest or need in an area, providing access to BQA Transportation programming may also be of benefit.

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