EVALUATION BRUISES INCIDENCE IN CATTLE SLAUGHTERED IN A SLAUGHTERHOUSE LOCATED IN SÃO PAULO, BRAZIL

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ABSTRACT

Pre-slaughter handling of cattle can increase animal stress, making them more susceptible to carcass bruising. Such bruising negatively impacts the beef production chain, affecting both producers and slaughterhouses. In this context, the present study aimed to evaluate the incidence of bruises in cattle carcasses at a slaughterhouse located in the northwest region of São Paulo State, Brazil, under the supervision of the State Inspection Service (SISP). A total of 1,068 carcasses were assessed between September and December 2021. Data were collected on breed type, sex, age, travel distance, and truck model, along with the extent, severity, and location of the bruises. Among the evaluated carcasses, 64.7% were crossbred (zebu and taurine). The findings indicated that older females, with slaughter age of 25 to 36 months, were more susceptible to bruises compared to males. The hindquarter cuts were the most affected areas, with a predominance of bruises in animals transported by truck over distances of 101 to 150 km. Furthermore, the most frequent bruises were classified as grade II (51.4%) and measured between 6 and 10 cm in size (36.8%). Various factors contribute to the occurrence of bruises in beef cattle such as racial pattern, gender, age and distance travel, however, most of these factors could be prevented or mitigated through proper management practices during the pre-slaughter period.

Keywords animal welfare, bovine transport, bruises.

AVALIAÇÃO DA OCORRÊNCIA DE HEMATOMAS EM BOVINOS ABATIDOS EM UM ABATEDOURO-FRIGORÍFICO ESTADUAL EM SÃO PAULO, BRASIL

RESUMO

O manejo pré-abate de bovinos pode promover maior risco de estresse nos animais e torná-los propensos a ocorrência de hematomas na carcaça. Os hematomas representam um impacto negativo nas plantas processadoras de carne bovina, desde produtores até abatedouro-frigorífico. Sabendo disso, este estudo teve como objetivo avaliar o índice de hematomas encontrados nas carcaças de bovinos abatidos em um frigorífico localizado no Noroeste do Estado de São Paulo, vinculado ao Serviço de Inspeção Estadual (SISP), onde foram avaliadas 1.068 carcaças, entre os meses de setembro e dezembro de 2021. Foram coletados dados como padrão racial, sexo, idade, distância percorrida e modelo do caminhão, analisando também a extensão, intensidade e localização das lesões. Das carcaças avaliadas, 64,7% eram mestiços (zebuíno e taurino). Ao final da coleta foi possível observar que as fêmeas, com idade de abate de 25 a 36 meses, são animais mais suscetíveis a lesões quando comparadas aos machos. Os locais mais afetados foram os cortes dos posteriores. Com predomínio de lesões em animais transportados por caminhão, nas distâncias de 101 km e 150 km. Além disso, as lesões identificadas em maior proporção foram as de grau II (51,4%) e com extensão de 6 a 10cm (36,8%). Existem vários fatores que influenciam a ocorrência de hematomas em bovinos de corte como o padrão racial, sexo, idade e distância percorrida, mas a maioria desses fatores poderia ser evitada ou minimizada com manejo adequado no período pré-abate.

Palavras-chave bem-estar animal, transporte bovino, contusões.

INTRODUCTION

In beef production, Brazil stands out as the second largest producer and the first exporter in the world, with a herd of 238.6 million animals (IBGE, 2023). It is estimated that large amounts of beef are consumed by Brazilians (PELAYO et al., 2019). In 2023, Brazil exported 2.26 million tons of beef, sold to more than 150 countries (ABIEC, 2023). Being among the largest beef producers, Brazil, industries and meat-consuming citizens are concerned about the possible occurrence of mistreatment.

Carcass evaluation in slaughterhouses can provide insights into how animals have adapted to their breeding environment and whether they were subjected to mistreatment during pre-slaughter handling (GENARO, 2024). The occurrence of mistreatment in cattle can be assessed through a quantitative examination of carcasses, focusing on the presence of bruises and other characteristics such as their location, severity, and shape (BARINGTON et al., 2020).

Bruises on carcasses are considered early and common signs, easily recognized that a welfare-related problem occurred during transport and pre-slaughter operations (SARAIVA et al., 2020). A bruise is found under the intact epidermis and consists of an extravascular collection of erythrocytes from blood vessels damaged by some type of mechanical impact (GENARO et al., 2021).

Although previous studies have evaluated the occurrence of bruises in cattle carcasses associated with mistreatment, this research to investigate how variables such as breed, sex, age, and transportation distance are related to the type, severity, and location of the observed lesions. Longer transportation distances, along with differences in breed, sex, and age, may be significantly associated with an increased incidence, severity, and specific distribution of bruises in cattle carcasses. Therefore, the objective of this study was to evaluate the occurrence and characteristics of bruises in cattle carcasses slaughtered in the Northwest region of São Paulo, under the supervision of the State Inspection Service (SISP).

MATERIAL AND METHODS

The present work was carried out between September and December 2021, in a slaughterhouse located in the Northwest of the State of São Paulo, with a plant

inspected by the State Inspection Service (SISP). This slaughterhouse has a slaughtering capacity of 500 animals/day and sells only quarters. Thirty-two groups of animals were evaluated, totaling 1068 animals, corresponding to 2136 half-carcasses.

Ante-mortem data collection

Upon the arrival of the animals at the slaughterhouse, data from the Animal Transit Guide (GTA) were analyzed based on intrinsic factors—such as cattle breed, sex (female/male), and age—and extrinsic factors, including the estimated distance between the farm and slaughterhouse (based on the origin), time spent at the slaughterhouse, type of vehicle used for transport, and the model and average capacity of the vehicle. Vehicles transporting animals were divided into: (1) truck-type with the capacity to transport 16 to 18 fat cattle; (2) low truck with capacity to transport 30 fat cattle and (3) double deck with capacity to transport 35 to 40 fat cattle. "Fat cattle" is considered a male bull of 240 kg. At the time the animals were destined for slaughter, the period of fasting and water diet to which they were submitted was recorded.

Post-mortem data collection

The lesions were visually evaluated on the slaughter line, right after the skinning step and before evisceration. Injuries were considered as bruises that were classified as recent (bright red coloration) or old (yellowish coloration). The intensity of the lesions was classified into degree I (subcutaneous tissue only), degree II (cutaneous and muscle tissue) and degree III (subcutaneous tissue, muscle, and bone) (AVMA, 2024).

About size, the lesions were classified into five basic categories, according to the surface area of the lesion, in level I (1 to 5cm in diameter), level II (6 to 10 cm in diameter), level III (from 11 to 15 cm in diameter), level IV (from 16 to 20 cm in diameter) and level V (diameter greater than 21 cm). Lesions smaller than 1 cm in diameter were not registered (LOSADA-ESPINOSA et al., 2021).

The assessments were conducted daily from September to December 2021 in the morning and were consistently performed by the same individual throughout the entire evaluation period. Both sides of the half-carcasses were examined.

Location of lesions in commercial cuts

During slaughter, each half-carcass was evaluated individually and the lesions characteristics were noted on an individual sheet, which, through an image, determined their location in the cuts of each animal. The presence of lesions in commercial cuts standardized for the domestic market by Ordinance SIPA n° 5, of 8/11/1988 (BRAZIL, 1988) were evaluated.

Statistical analysis

A descriptive analysis of the absolute and relative frequencies referring to the number of lesions was performed. Statistical analysis includes chi-square test of independence ($p<0.05$), with Bonferroni correction, to verify the existence of significant differences between observed injuries and observed factors. All analysis was conducted on SPSS Statistics software.

RESULTS AND DISCUSSION

Racial Pattern

Of the 1,068 slaughtered beef cattle, 624 were crossbred (Zebu × Taurine) and 444 were purebred Zebu. A total of 566 lesions were observed, 64.7% (366/566) in crossbred cattle and 35.3% (200/566) in Zebu. A significant association was found between the presence of lesions and the breed type of slaughtered cattle [$X^2(1) = 19.287$, $p < 0.05$]. Furthermore, crossbred animals presented a significantly higher proportion of lesions in their half-carcasses compared to Zebu animals (Table 1).

Table 1: Results in absolute and relative values regarding the occurrence of lesions in bovine carcasses according to the racial pattern of slaughtered animals.

RACIAL PATTERN	TOTAL ANIMALS	ABSOLUTE VALUE	RELATIVE VALUE
CROSSED	624	366	64.7%[a]
ZEBU	444	200	35.3%[b]

Different letters in the same column indicate a significant difference for ($p < 0.05$).

In the study by Anezi Junior and Carvalho (2021), the breed composition of the slaughtered batches did not significantly influence ($p < 0.05$) the occurrence and severity of bruises. The authors reported that mixed batches, consisting of Zebu cattle and their crossbreeds, showed a higher percentage of injured animals and greater

losses in the anterior, posterior, and rib regions, as well as higher average losses across all lesions. The only exception reported was that adult European females exhibited greater losses in the forequarters compared to adult crossbred females.

In Brazil, the cattle herd includes a predominance of breeds of Indian origin (*Bos taurus indicus*), specifically the Nelore, although crosses between these breeds and those of European origin (*Bos taurus taurus*) are also frequent. The individual behavior of the animal usually varies within genetic groups, however the use of crossbreeds in different genetic portions can provide diversity both in the type and in the behavior of the animal (VAZ et al., 2023), which can explain our results.

Animal Sex

A total of 631 animals were females, while 437 were males. According to the total number of lesions observed, it was found that 65.4% (370/566) occurred in females and 34.6% (196/566) in males. There was a significant association between the occurrence of lesions and the sex of the slaughtered animals [$X^2(1)$ = 19.698, $p < 0.05$]. Furthermore, a statistically significant difference was found when comparing the number of lesions between males and females in the half-carcasses (Table 2).

Table 2: Results in absolute and relative values regarding the occurrence of lesions in bovine carcasses according to the sex of slaughtered animals.

SEX	TOTAL ANIMALS	ABSOLUTE VALUE	RELATIVE VALUE
FEMALE	631	370	65.4%[a]
MALE	437	196	34.6%[b]

Different letters in the same column indicate a significant difference for ($p < 0.05$).

Bethancourt-Garcia et al. (2019) mentioned that the reactivity of female cattle can be measured by the number of lesions on carcasses. They reported that females have 73% more probability to present bruises than steers. When evaluating the probability of excitable behavior in male and female cattle, Vaz et al. (2023) identified that lots of females are 70.7% more likely to exhibit excitable behavior.

The higher incidence of excitable behavior and, consequently, bruising in females may be associated with greater reactivity to adverse situations, potentially due to specific experiences such as gestation, parturition, and subsequent calf weaning (MOTA-ROJAS et al., 2024). Additionally, females typically remain in breeding systems longer than males and are often subjected to inadequate nutritional management (D'OCCHIO et al., 2019), being sent to slaughter when their reproductive

capacity declines.

Age of Animal

A total of 221 cattle aged between 13 and 24 months, 518 aged between 25 and 36 months and 329 aged over 36 months were studied. According to the total number of lesions observed (566), 14.0% (79) were found in animals aged between 13 and 24 months, 50.5% (286) in animals aged between 25 and 36 months and 35.5% (201) in animals aged over 36 months. There was an association between the number of lesions and the age of the slaughtered cattle [$X^2(2) = 36.081$; $p<0.05$]. A statistically significant difference was observed between the animals slaughtered at the age of 13 and 24 months and the others (Table 3).

Table 3: Results in absolute and relative values regarding the occurrence of lesions in bovine carcasses according to slaughter age.

AGE (months)	TOTAL ANIMALS	ABSOLUTE VALUE	RELATIVE VALUE
13 a 24	221	79	14.0%[a]
25 a 36	518	286	50.5%[b]
> 36	329	201	35.5%[b]

Different letters in the same column indicate a significant difference for ($p < 0.05$).

Bovine dairy females that are destined for meat production end up being a way of saving or killing females in the final stage of production (MOREIRA et al., 2021). This participation of dairy cows in meat production varies according to the country of origin, given that the sale of these females represents a significant portion of the total monetary income of dairy herds (McWHORTER et al., 2020). In the European Union (EU), dairy cows going to slaughter represent about 27% of total beef production (EUROPEAN COMMISSION, 2022).

Traveled Distance

The majority of the animals traveled distances between 101 and 150 km, which was also the category with the highest number of bruises (34.5% - 195/566) (Table 4). There was an association between the number of lesions and the distance covered by the animals [$X^2(3) = 8.512$; $p<0.05$].

The highest incidence of bruises in cattle did not occur during the longest distance traveled but rather during the second longest. This finding is consistent with Lee et al. (2018), who reported that the handling involved in loading and unloading

Table 4: Results in absolute and relative values for the occurrence of injuries in bovine carcasses according to the distance traveled by the animals between the properties and the slaughterhouse.

TRAVELLED DISTANCE (km)	TOTAL ANIMALS	ABSOLUTE VALUE	RELATIVE VALUE
< 50	305	170	30.0%[ab]
51 a 100	161	69	12.2%[b]
101 a 150	367	195	34.5%[a]
> 151	235	132	23.3%[ab]

Different letters in the same column indicate a significant difference for ($p < 0.05$).

poses a greater risk of bruising than the distance traveled during transport. Therefore, it is often not the distance to the slaughterhouse that results in the greatest economic loss, but rather the pre-slaughter handling.

Among the conditions related to bovine pre-slaughter, the time spent in transport is one of the most influential factors affecting animal welfare. Physical exhaustion during transportation, combined with the stress experienced by the animals and factors related to confinement within the vehicle, plays a significant role (NJISANE and MUCHENJE, 2017). Additionally, the movement of the vehicle involves frequent braking and acceleration, constant vibration, unfamiliar noises and odors, temperature fluctuations, and restricted access to food and water (CLARIGET et al., 2021), all of which can contribute to alterations in animal behavior.

The distance traveled is also associated with the occurrence of fatigue and muscle damage in animals during transportation over longer distances, primarily due to the need for the animals to brace against the movement of the trucks and remain standing for extended periods (ROADKNIGHT et al., 2020).

The association of these transport-related factors can contribute to an increase in the number of bruises in cattle that will be slaughtered, thus, it is believed that long journeys can be harmful to the animals. In this study, the maximum displacement evaluated was greater than 151 km, which if evaluated at this exact value, would be related to a travel time of approximately 2 hours.

Truck Model

The truck-type transported 162 animals, with 14.5% (82/566) of them bruises. The double deck model was used for the locomotion of 325 animals, where 31.5% (179/566) of them had some type of bruise. Transport carried out by low truck totaled 581 animals, with 53.9% (305/566) of them having bruises on their carcasses (Table 5).

No association between the number of injuries and the type of transport used

to take the animals from the properties to the slaughterhouse was observed [$X^2(2)$ = 0.991; $p>0.05$].

Table 5: Results in absolute and relative values for the occurrence of injuries in bovine carcasses according to the type of transport used between the properties and the slaughterhouse.

TRUCK MODEL	TOTAL ANIMALS	ABSOLUTE VALUE	RELATIVE VALUE
Truck-type	162	82	14,5%[a]
Low truck	581	305	53,9%[a]
Double Deck	325	179	31,6%[a]

Different letters in the same column indicate a significant difference for ($p < 0.05$).

Vaz et al. (2023) reported that higher stocking densities and longer travel times during transportation negatively impact cattle behavior in the pre-slaughter period. They recommend limiting travel to no more than 6 hours and maintaining a load density of no more than 350 kg/m² per vehicle, with special attention given to female groups. Similarly, Özdemir and Ekiz (2023) indicated that the high prevalence of bruises observed in their study may have been due to the absence of loading ramps on farms, leading to increased coercion during loading. Therefore, not only travel duration and transport conditions but also on-farm handling practices play a critical role in the occurrence of bruises.

Adequate space for cattle determines better performance and profitability, in addition, transport to the slaughterhouse is for many animals a new and stressful situation that can determine changes in their behavior (BETHANCOURT-GARCIA et al., 2019; BOTÍA et al., 2024). In restricted spaces for each animal, the environment is not conducive to maintaining the unaltered behavior of cattle, with violation of individual space resulting in a greater number of encounters between animals and making them more aggressive and excitable (VAZ et al., 2023; DEL CAMPO et al., 2021).

Intensity and Extent of Lesions

A percentage of 42.1 (415) had degree I (subcutaneous) bruises, 51.4 (506) had some type of degree II injury (subcutaneous and muscular) and only 6.5 (64) degree III lesions (subcutaneous, muscle and bone). Regarding extension, level I lesions (1 to 5 cm) affected 8.5% (83) of the animals, level II lesions (6 to 10 cm) were observed in 36.8% (359), level III (11 to 15 cm) lesions were present in 24.0% (234), level IV lesions (16 to 20 cm) affected 14.3% (140) of the slaughtered animals and those of level V (>21

cm) were observed in 16.4% (160) animals.

An association was observed between the intensity and extent of the bruises [$X^2(2)$ = 497.735, p < 0.05], along with a statistically significant difference across different degrees of severity (Grade I, Grade II, and Grade III). Similarly, an association [$X^2(4)$ = 289.516, p < 0.05] and a statistically significant difference were observed for bruise size. However, bruises measuring 16–20 cm and those larger than 21 cm did not differ significantly from each other (Table 6).

Table 6: Results in absolute and relative values regarding the intensity and extent of lesions in slaughtered animals.

LESIONS	VARIATION	ABSOLUTE VALUE	RELATIVE VALUE
	Degree I	415	42.1%[a]
INTENSITY	Degree II	506	51.4%[b]
	Degree III	64	6.5%[c]
	Level I	83	8.5%[b]
	Level II	359	36.8%[d]
EXTENSION	Level III	234	24.0%[c]
	Level IV	140	14.3%[a]
	Level V	160	16.4%[a]

Different letters in the same column indicate a significant difference for (p < 0.05).

Regarding the classification and quantification of bruises in carcasses of slaughtered cattle, similar results were found by Anezi-Júnior and Carvalho (2021), who detected 56.25% of grade I bruises, 15.26% of injuries were grade II and only 1.22% of the hematomas found in the survey were grade III, affecting the subcutaneous, muscular and bone layers.

Bethancourt-Garcia et al. (2019), reported that the actual damage of a grade I contusion is difficult to identify in the slaughterhouse. One hour after the injury occurred, macroscopic appearance changes depend on the impact force and consequently classify the severity and amount of affected tissue (Barington et al., 2016). This is confirmed by verifying the low occurrence of grade I injuries in the present study.

Location of Lesions

The greatest number of injuries occurred in the hind limbs and rib. In the rib, 24.2% (236) of the lesions were observed, 23.7% (229) in the outside and 19.5% in the rump steak. Another heavily affected cut was loin 15.5% (150) and shoulder clod 12.8% (124). Flank steak was the cut with the lowest number of bruises - 4.1% (40).

There was an association between the number of lesions and the carcass cuts

of slaughtered cattle [$X^2(5)$ = 202.041; p<0.05]. The forequarter (shoulder clod), showed statistical difference from the other cuts (hind), except for loin. In the rear cuts, Rump Steak and Loin did not differ statistically from each other, in the same way as Rib and Outside, as shown in (Figure 1).
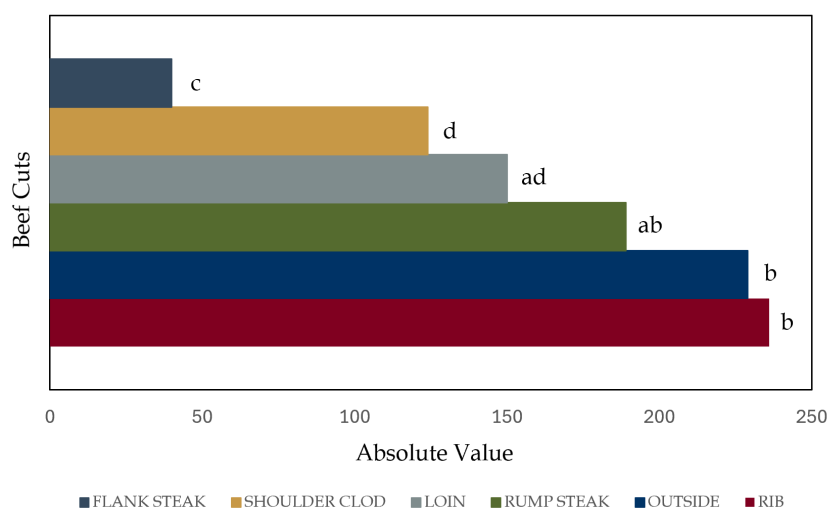
Figure 1: Results in absolute and relative values regarding the location of lesions in slaughtered animals. Different letters indicate a significant difference for (*p* < 0.05).

Nespolo et al. (2022) evaluated the occurrence of bruises in bovine carcasses and demonstrated that the highest number of bruises occurred in the hindquarter, with an average incidence of 86%. Among the various cuts, the highest occurrence was observed in the external flat part. Similarly, a study by Youngers et al. (2017) reported a greater distribution of bruises along the dorsal midline, which the authors characterized as the hindquarters. The higher incidence of injuries in the posterior anatomical region of cattle may be attributed to the presence of larger muscle groups in this area, making it more susceptible to injury (VICIC et al., 2025).

CONCLUSION

Hematomas in beef cattle are mainly influenced by breed, sex, age, and transport conditions. However, most of these factors can be prevented or minimized through proper management during the pre-slaughter period. The predominance of lesions in the hind limbs, often associated with inadequate transportation, underscores the need for ongoing awareness of the economic losses involved. Furthermore, it emphasizes the importance of animal welfare as a critical component for the quality and sustainability of the production chain.

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