BIA
BOLETIM DE INDÚSTRIA ANIMAL

ANIMAL PRODUCTS QUALITY

OCCURRENCE OF INJURIES RELATED TO HANDLING IN CARCASSES OF BEEF CATTLE SLAUGHTERED IN A SLAUGHTERHOUSE LOCATED IN THE NORTHWEST REGION OF THE STATE OF SÃO PAULO

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Received: 09/04/2022
Approved: 30/11/2022

Abstract

This study aimed to evaluate the occurrence of injuries in bovine carcasses slaughtered in the northwest of São Paulo, through the quantification of the number of these injuries and their location in the main Brazilian commercial courts. Five ranchers were randomly selected, differentiated by the acronyms PEC A (rancher A), PEC B (rancher B), PEC C (rancher C), PEC D (rancher D) and PEC E (rancher E), which totaled 333 evaluated carcasses. The results showed that the majority of the slaughtered animals were of the Nellore breed and females of different age groups. There was a variation in the fasting period and water diet established for the animals, with the PEC C being the shortest period and in the others the variation was 10 to 16 hours. As for the injuries, it was possible to observe that the greater the distance covered, the greater the percentage of injuries in the half carcasses, with the rear quarter being more affected, especially the thigh, followed by the rump. Factors such as age and duration of transport positively influenced the percentage of injuries and even with the intense discussions and quality programs aimed at the application of animal welfare, the bovine half carcasses analyzed in the present study showed a high incidence of injuries.

Keywords bruises; half-carcasses; rear quarter; quality.

OCORRÊNCIA DE LESÕES RELACIONADAS AO MANEJO EM CARCAÇAS DE BOVINOS DE CORTE ABATIDOS EM ABATEDOURO FRIGORÍFICO LOCALIZADO NA REGIÃO NOROESTE DO ESTADO DE SÃO PAULO

Resumo

O presente trabalho teve por objetivo avaliar a ocorrência de lesões em carcaças bovinas abatidas no Noroeste paulista, por meio da determinação do número destas lesões e sua localização nos principais cortes comerciais brasileiros. Foram selecionados aleatoriamente cinco pecuaristas, diferenciados pelas siglas PEC A (pecuarista A), PEC B (pecuarista B), PEC C (pecuarista C), PEC D (pecuarista D) e PEC E (pecuarista E), que totalizaram 333 carcaças avaliadas. Os resultados mostraram que a maioria dos animais abatidos eram da raça Nelore e fêmeas de diferentes faixas etárias. Houve uma variação no período de jejum e dieta hídrica estabelecidos aos animais, sendo que o PEC C, foi o menor período (3 horas) e nos demais a variação foi de 10 a 16 horas. Quanto as lesões, foi possível observar que quanto maior a distância percorrida, maior a porcentagem de lesões nas meias carcaças, sendo o quarto traseiro mais acometido, principalmente o coxão, seguido da alcatra. Fatores como idade e duração do transporte influenciaram de forma positiva a porcentagem de lesões e mesmo com as intensas discussões e programas de qualidade que visam a aplicação do bem-estar animal, as meias carcaças bovinas analisadas no presente estudo apresentaram alta incidência de lesões.

Palavras-chave contusões; hematomas; meias-carcaças; quarto traseiro; qualidade.

INTRODUCTION

The increase in the population's interest in the management and care related to production animals, including beef cattle, intensified the concern with the hygienic-sanitary conditions of the slaughterhouses, as well as with the maintenance of animal welfare, both in production and in in pre-slaughter (GONÇALVES e SALOTTI-SOUZA, 2017; SONODA et al., 2017).

An important factor in pre-slaughter management are transport conditions, such as truck load density (Kg/m2), transport time to the slaughterhouse, time of food and water restriction, environmental conditions of transport and conditions of highways, which can interfere unfavorably with animal welfare, increasing the physical effort of animals and providing psychological stress, which ends up intensifying the presence of "dark cuts" and even injuries (SOUZA et al., 2021).

The reduction in the glycogen reserve causes metabolic and hormonal changes in the muscle of the live animal, altering the color and pH in the *post-mortem* muscle, due to the low production of lactic acid in the carcass (LOREDO-OSTI et al., 2019). The "dark cut", also called *Dark, firm, and dry* is associated with long transport distances, due to the consumption of a large part of muscle glycogen caused by the stressor to which the animal was subjected.

Related to transport conditions, especially during loading and unloading of animals, is the lack of preparation of operators responsible for driving these cattle. During the boarding and disembarkation process, pieces of wood or electrical equipment are used to hasten the movement, causing agitation and disordered movement, which can cause slips and falls, and this behavior is often considered harmless by animal handlers (BERTOLONI et al., 2012; LUDTKE et al., 2012; CEBALLOS et al., 2018).

The difficulty encountered in increasing beef productivity in Brazil is related to the losses that occur throughout the production chain, one of which is reflected in the impairment of beef cuts due to inadequate conditions both in the pre-slaughter management of the animals and during transport procedures, which must be carried out by properly qualified professionals for the application of the necessary procedures, in addition to the use of adequate facilities (MENDONÇA et al., 2016).

In slaughterhouses it is possible to assess the presence of bruises and bruises

on the carcasses. This assessment is important for two main reasons: (1) for meat quality analysis and carcass valuation, particularly in high value cuts and (2) for verification of animal welfare regarding the harmful situations suffered by animals before slaughter (STRAPPINI et al., 2012).

The forequarter is subdivided into two large pieces which are the pallet and the forequarter without the palette. The palette is a large piece obtained by sectioning the muscles around the scapular and brachial regions, which separate them from the large front-without-palette piece. The hindquarter is subdivided into saw hindquarter and needle point, where the saw hindquarter is further subdivided into three large pieces: loin, rump and thigh and the needle point are the large piece made up of the muscular masses that cover the last eight ribs, the last sternebra, the xiphoid process and the void region and subdivided into the hind rib and void (BRASIL, 1988).

Based on the above, the objective of this study was to characterize the batches of slaughtered animals and evaluate the occurrence of injuries resulting from handling in carcasses of cattle slaughtered in the Northwest of São Paulo, by quantifying the number of these injuries and their location in the main Brazilian commercial cuts.

MATERIAL AND METHODS

The present work was carried out from March to May 2019, in a slaughterhouse located in the Northwest of the State of São Paulo. The refrigeration plant is inspected by the State Inspection Service (SISP), which specifies an establishment subject to permanent inspection. The slaughterhouse has a slaughtering capacity of 500 animals/day. The analyzes were carried out at the establishment itself.

Before slaughter, five ranchers were randomly selected to evaluate their respective batch of animals, totaling 333 animals. Of these, 100 cattle from rancher A (PEC A), 80 cattle from rancher B (PEC B), 69 cattle from rancher C (PEC C), 30 cattle from rancher D (PEC D) and 54 cattle from rancher E (PEC E). Management variables were then evaluated before and during slaughter.

Management variables *ante-mortem*

Upon arrival of the transport vehicles at the slaughterhouse, the transport procedure was evaluated through visual analysis and observation of data from the Animal Transit Guide (ATG), the breed of cattle, sex (F/M), distance traveled and time

of route. When the animals were destined for slaughter, the period of fasting and water diet to which the animals were submitted was recorded.

Animal stunning variables

The stunning was performed mechanically, using a penetrating captive dart pistol. The effectiveness of stunning was assessed by recording any of the following signs of regained consciousness on the winch: spontaneous blinking, full eyeball rotation, rhythmic breathing, attempts to stand up and straighten while hanging, or vocalizations. If any of these signs in an animal were present, stunning was considered inappropriate.

Handling variables *post-mortem*

Injury assessments were performed visually at the slaughter line, right after the skinning step and before evisceration. Only deep (yellowish) and recent (bright red) bruises were considered injuries, in which there was muscle tissue involvement and intense red coloration due to blood accumulation, as Andrade et al. (2008). Superficial lesions, involving only the subcutaneous tissue, which had a light red color, without blood accumulation, were not considered.

Specification of the location of lesions in commercial cuts

During slaughter, each half-carcass was evaluated and numbered on an individual sheet, in which the occurrence and location of lesions in the cuts were delimited, still in the slaughter room. The presence of lesions in commercial cuts standardized for the domestic market by the Ordinance SIPA nº 5, de 8/11/1988 (BRASIL, 1988). The following commercial forequarter cuts were evaluated: shoulder and forequarter without shoulder. The following commercial cuts of the hindquarters were also evaluated: loin, rump, thigh, hind rib and empty (flank steak).

Ordinance 05/1988 establishes the standardization of cuts in cattle and defines quarters, as the subdivision of half-carcasses, which are divided into hind and forequarters, which are separated between the fifth and sixth ribs, as shown in the figure 1.

Statistical analysis

To evaluate the data, a descriptive analysis of the number of lesions found was

performed. Statistical analysis was performed using the SPSS Statistics software, using the chi-square test of independence ($p < 0.05$), with Bonferroni correction, to verify the existence of significant differences between the observed lesions and the factors studied.

Results and discussion

According to the characterization of the animals received by the slaughterhouse from the five selected ranchers, the predominant breed was the Nelore, and only PEC A also had crossbred animals in the same batch. The PEC E was the only one that presented male animals at slaughter, the others were all females with an average age varying between the ranchers: PEC A and PEC D mean of 36 months of slaughtered animals, PEC B 54 months, PEC C 48 months and PEC And age ranging from 24 to 36 months. Another variation identified among the ranchers was in the rearing system: PEC A, PEC B and PEC E the animals belonged to a semi-intensive rearing system, an extensive PEC C and PEC D intensive rearing system.

Regarding the period of fasting and water diet, evaluated from the removal of food from the animals on the rural property, it is possible to verify in table 1 that the PEC C presented the shortest time, accounting for a total of three hours and 40 minutes. The other producers (PEC A, PEC B, PEC D and PEC E) presented a sum of 24 hours, 17 hours, 23 hours and 11 hours and 30 minutes, respectively. Ordinance 365/2021 establishes that for cattle, the fasting period must not exceed 24 hours, and the maximum fasting time must be counted from the withdrawal of food from the animals still on the rural property (BRASIL, 2021). The Regulation for Industrial and Sanitary Inspection of Products of Animal Origin (RIISPOA) establishes that the slaughter of animals that have not remained at rest, fasting and water diet is prohibited (BRASIL, 2017).

Clariget et al. (2021), described that the effects of stress reflected in the quality of the meat can be explained not only by the resting time in the establishment, but also by the animal's temperament, breed, handling procedures from the farm to slaughter, conditions of the establishment's corrals and even climatic conditions. The ideal time for resting, fasting and water diet is divergent among researchers, considering the need for rest to restore the glycogen reserve. Costa et al. (2019) found that the long time spent in the slaughterhouse does not improve the quality of the meat, as this long

Table 1: Results regarding the mileage traveled, travel time and fasting period and water diet of cattle slaughtered in a slaughterhouse located in the Northwest of the State of São Paulo.

BATCH	**MILEAGE TRAVELED** (km)	**ROUTE TIME**	**PERIOD OF FASTING AND WATER DIET**	**SUM** (Route + fasting)
PEC A	330	8h	16h	24h
PEC B	70	2h	15h	17h
PEC C	30	40min	3h	3h40min
PEC D	350	8h	15h	23h
PEC E	55	1h30min	10h	11h30min

Cattleman A (PECA), Cattleman B (PECB), Cattleman C (PECC), Cattleman D (PECD) e Cattleman E (PECE).

time can deplete the glycogen reserves, thus reducing the quality of the meat.

The rest period or water diet in the slaughterhouse is the time necessary for the animals to fully recover from the disturbances caused by the displacement from the place of origin to the slaughterhouse (ROÇA, 2002). Rest and fasting applied to animals have as main objective to reduce the gastric content to facilitate the evisceration of the carcass and restore muscle glycogen reserves (THORTON, 1969). Fasting time is often confused with the resting time of animals in the slaughterhouse. It must be considered that the animals have been fasting for food since their containment in the corrals of the property and that this period is added to the travel time to the establishment.

Current European Union legislation defines long trips as those that take more than eight hours and short trips would last a maximum of four hours (EU, 2004, EUROPEAN COMMISSION, 2009). In table 1 it is possible to observe that the animals transported from PEC A and PEC D made eight-hour journeys, while PEC B, PEC C and PEC E had shorter journeys and consequently shorter travel time, 2 hours, 40 minutes and 1 hour and 30 minutes respectively.

Evaluating tables 1 and 2, it is possible to observe that in places where the distance traveled and the travel time were longer, eight hours for both PEC A and PEC D, a higher percentage of injuries were identified in the half-carcasses. In PEC A, where the distance covered was 330 km, 31 (31%) carcasses with lesions were identified, which corresponded to 56 (28%) half-carcasses, in PEC D with a distance traveled of 350 km, 20 were identified (66.67 %) carcasses with lesions, accounting for 33 (55%) half-carcasses with lesions, already in PEC B with a distance traveled of 70 km and travel time of two hours, that is, six hours less than PEC A and PEC D, were

29 (36.25%) carcasses with lesions were identified, accounting for 51 (31.87%) half-carcasses with lesions, but the average age of the animals of this rancher was the highest among the five evaluated, with animals of 54 months.

Hoffman e Lühl (2012), reported that factors such as advanced age at slaughter can make females more prone to bruising when compared to young animals. Older animals tend to show more bruising in the event of traumatic events, which is probably a consequence of negative experiences during their lives, related to more intense escape reactions, which can lead to injuries (LOSADA-ESPINOSA et al, 2021).

Garcia et al. (2019) in a study carried out in a slaughterhouse located in Rio Grande do Sul, they observed that male bovines have 73% less chance of having bruises on the carcasses when compared to females. This fact may be the result of a greater reactivity of females when compared to males, in addition to differences in physical conditions between cattle of different sexes, such as skin thickness and fat layer, which influence the occurrence of bruises (RILEY et al., 2014). In the present work, only PEC E had males in the slaughtered lot, which was the lot in which a smaller number of lesions were identified.

Andrade et al. (2008) evaluated the transport conditions of 121 cattle in the Pantanal Mato-Grossense, with distances ranging from 20 to 471 km and did not observe significant differences in relation to the greater or lesser number of lesions identified in the half-carcasses. Bertoloni et al. (2012), evaluating animals driven over short distances (75 to 130 km) and long distances (180 to 250 km), observed rates of more than 60% of injuries on the long route.

Mendonça et al. (2018), did not observe a clear pattern for the average number of injuries per load as the duration of the trip increased, making it possible to perceive that along with the duration of the trip, there are other factors associated with the incidence of injuries during transport, such as the presence of animals with horns, drivers have not been trained, road conditions and conditions for handling animals during loading.

In evaluating the effectiveness of stunning, it was possible to identify that all 333 stunned cattle did not show signs of regained consciousness in the winch. In table 2, it is possible to see that the highest percentage of injuries was identified in the hind quarter, 86.44% of the total of half-carcasses evaluated, in the forequarter, a total of 15.81% injuries were identified, a similar value in the identification of socks-carcasses

that showed injuries to both the forequarter and hindquarter (15.25%). In addition, the chi-square test of independence showed that there is an association between the number of lesions in the evaluated half-carcasses and the ranchers [$X^2(4) = 47.425$; $p<0.05$]. There was no statistically significant difference between ranchers A and B (PEC A e PEC B).

Table 2: Results of the percentage of lesions found in half-carcasses, lesions located specifically in the hindquarters, forequarters and in both places of cattle slaughtered in a slaughterhouse located in the Northwest of the State of São Paulo.

BATCH	TOTAL HALF-CARCASSES EVALUATED	HALF-CARCASSES WITH INJURIES	INJURIES		
			HINDQUAR-TER*	FOREQUAR-TER*	HIND AND FOREQUAR-TER*
PEC A	200	28.00%[a]	78.57%	17.85%	16.07%
PEC B	160	31.87%[a]	90.19%	11.76%	15.68%
PEC C	138	19.56%[b]	81.48%	14.81%	7.40%
PEC D	60	55.00%[c]	100%	18.18%	21.21%
PEC E	108	9.25%[d]	80.00%	20.00%	10.00%
TOTAL	**666**	**26.57%**	**86.44%**	**15.81%**	**15.25%**

Different letters in the same column indicate a significant difference for p(<0.05).
PEC A: Cattleman A; PEC B: Cattleman B; PEC C: Cattleman C; PEC D: Cattleman D; PEC E: Cattleman E.
* The data did not meet the prerequisites of the statistical test (cells counting less than 5).

Regarding the cut affected by the lesion, in each quarter a single lesion and even four lesions were found in the same quarter in different bovine cuts (Figure 2). In Figure 2, it is possible to verify that the cut of the hindquarter most affected by the lesions identified in the different batches was the thigh, ranging from 32.86% (PEC A) to 50% of the lesions on the thigh (PEC E). Another portion of the hindquarters frequently affected by injuries was the rump, with a percentage of 22.86% in PEC A, 25.71% in PEC B, 32.14% in PEC C and 19.15% in PEC D, already in PEC E, the percentage of lesions in the rump was like the other cuts, being 10%.

Loin, hind rib, and emptiness were the least affected portions of the hindquarters. In the forequarter, injuries were found both in the shoulder blade and in the forequarter without a shoulder blade. In PEC E, 20% of the lesions were in the shoulder blade, but no lesions were identified in the forequarter without shoulder blade (Figure 2).

When boarding the animals on the rural property and when disembarking them at the establishment, many difficulties encountered by the handlers result in mistreatment and excessive use of sharp instruments, stingers, and especially electric shocks to the animals, which are applied to the hind limb of the animals aiming at boarding. and disembarkation (MENDONÇA et al., 2016). Pogorzelski et al. (2021),

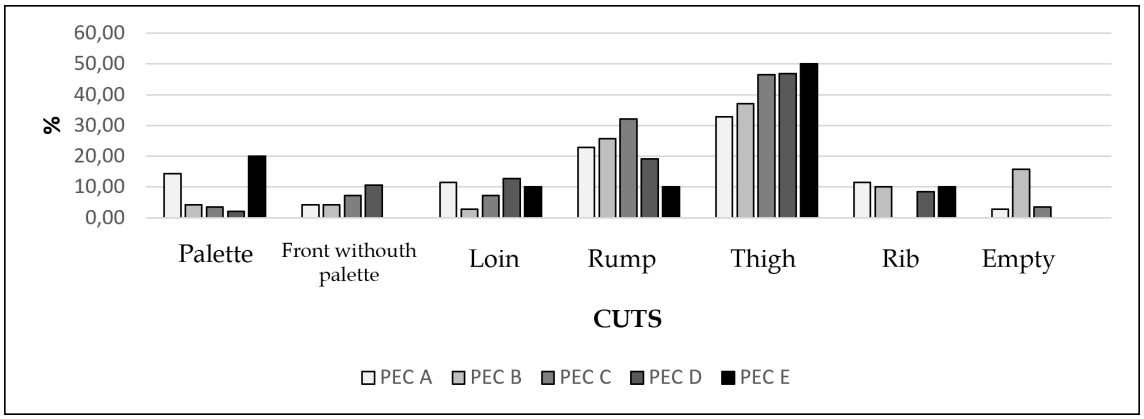

Figure 2: Main bovine cuts affected by the lesions identified in a slaughterhouse under state supervision. Cattleman A (PEC A), Cattleman B (PEC B), Cattleman C (PEC C), Cattleman D (PEC D) e Cattleman E (PEC E).

state that the incorrect use of these instruments, with the purpose of attacking the animals, generates reactive variations in the animals and the possibility of the occurrence of injuries and bruises.

Current Brazilian legislation establishes that the loading, unloading, and handling of animals in pre-slaughter handling must be carried out with instruments that do not cause injuries, pain or unnecessary agitation, and the use of sharp instruments and whips is prohibited. In animals that refuse to move, the use of devices producing electrical discharges is allowed, but with some care: (1) be applied preferably to the hind limbs, with discharges that do not last more than one second and even where there is space for the animal to get up; (2) do not use electrical discharges in sensitive areas of animals (anus, genitals, head and tail); (3) the device must be connected to equipment that allows voltage regulation, monitoring and verification; (4) the device must not be connected directly to the establishment's electrical network (BRASIL, 2021).

Andrade et al. (2008), evaluated commercial cuts affected by lesions in cattle slaughtered in the Pantanal Mato-Grossense, found a higher rate of lesions also in the thigh and rump, but in a lower percentage than those in the present study, 16.60% and 15.90%, respectively.

Final Considerations

Factors related to the duration of transport positively influenced the percentage of injuries. In addition, even with the intense discussions and quality programs aimed at the application of animal welfare, in general, the bovine half

carcasses analyzed in the present study showed a high occurrence of lesions, concentrated mainly in the hindquarters and affecting in a higher percentage, the large portions called thigh and rump. More in-depth studies are needed to better understand the dynamics of these and other influencing factors, thus contributing to improving animal welfare conditions and, consequently, reducing the rate of injuries, helping to minimize losses in this process.

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