



Original article

## Economic losses due to hematoma in bovine carcasses from the north central mesoregion of Paraná

Perdas econômicas decorrentes de hematoma em carcaças bovinas provenientes da mesorregião norte central do Paraná

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### ARTICLE INFO

#### Article history

Received 04 December 2018

Accepted 12 June 2019

#### Keywords:

Contusions

Economic loss

Quality of meat

Animal welfare

#### Palavras-chave:

Contusões

Perda Econômica

Qualidade da carne

Bem Estar Animal

### ABSTRACT

Food security is important, and is being increasingly focused on during animal production. In bovine carcasses, we can find hematomas that are the consequences of traumas caused by several factors. These cause the extravasation of blood from vessels, causing the blood to accumulate in muscular tissues, which can then serve as a substrate for bacterial proliferation. The objective of this study was to quantify the occurrence of hematomas in bovine carcasses and to determine their degree of severity, to measure the economic impact these hematomas can cause. The slaughter of 385 animals was monitored, and 56.88% showed some type of hematoma. In injured animals, there were a total of 427 lesions, with an average of 1.94 of injuries per animal. There was a total loss of 65.7 kg of meat, with following proportional distribution: 12.32% in the front room (8.1 kg), 33.18% near the ribs and the lumbar region (21.8 kg), and 54.49% (35.8 kg) in the hindquarter. The resulting economic loss was calculated to be a total of US \$ 206.66 (R \$ 817.93). We conclude that the occurrence of hematoma lesions in bovine carcasses from the north central mesoregion of Paraná is responsible for economic losses.

### RESUMO

A segurança alimentar é importante e ganha a cada dia maior ênfase na produção animal. Nas carcaças bovinas, podemos encontrar hematomas que são consequências de traumas causados por diversos fatores, o que causa o extravasamento de sangue dos vasos, que acabam ficando contidos nos tecidos musculares, podendo servir de substrato para proliferação de bactérias. Objetivou-se quantificar a ocorrência de hematomas em carcaças bovinas e determinar o grau de severidade destes, a fim de mensurar o impacto econômico causado. Realizou-se o acompanhamento do abate de 385 animais e constatou-se que 56,88% apresentavam algum tipo de hematoma. Dentre os animais lesionados houve um total de 427 lesões, sendo em média 1,94 de lesões por animal. Perfazendo uma perda de 65,7 kg de carne no total, distribuídos em 12,32% no quarto dianteiro (8,1kg), 33,18% na região das costelas e lombar (21,8kg), e maior perda no quarto traseiro, sendo 54,49% (35,8 kg). O resultado econômico das perdas evidenciam um total de US\$ 206,66 (R\$ 817,93). Foi possível concluir que a ocorrência de lesões decorrentes de hematomas em carcaças bovinas provenientes da mesorregião norte central do Paraná é responsável por perdas econômicas.

### INTRODUCTION

Owing to the need to meet the requirements of the meat import market, advances have been made in assuring

quality and implementing good practices involved in bovine welfare at different stages, including production at the farm, transport, and slaughter (DEL CAMPO et al., 2014). The quality of the meat is influenced by several

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factors; among them are the stages of pre-slaughter, which includes farm management, transportation, and handling in the refrigerator. Of concern is the damage caused by inadequate pre-slaughter management, which is reflected in the carcass and manifested as contusions, vaccine abscesses, and other changes that are later removed in toilet. These damage the carcass and decrease its value for both the producer and for the ones involved in its trade (ANDRADE, COELHO, 2010). Andrade et al. (2009) report that inadequate pre-slaughter management reduces animal welfare; moreover, these authors report that the transport of cattle to the slaughterhouse has a great influence on the quality of the meat. Failures in this process cause various consequences in the carcass, such as bruises. It should be noted that according to the animal welfare rules established by the Ministry of Agriculture, Livestock and Supply, Chapter V, Article 14, bovine animals that are set for export are permitted to be transported by road for a maximum of 8 h (MAPA, 2017).

Bruises are invisible during ante-mortem inspections. When bruises are observed during post-mortem inspections, the affected meat should be discarded because of the risk of bacterial growth (CHAMBERS et al., 2004). Because the presence of bruises in the carcass is common, meat is frequently discarded, resulting in economic losses estimated at millions of dollars annually (HUERTAS et al., 2015). In addition to economic losses, Strappini et al. (2010) and Romero et al. (2013) describe that such bruises indicate failures in animal welfare during the pre-slaughter operations, and that their occurrence is due to the outflow of blood from the blood vessels in muscle bundles because of the presence of bruises. These result from physical strokes that are caused by rods, stones, or horns of cattle; they can also be induced by the falling of animals, which happens during the handling and the transport stages. Concurrently, carcass lesions also impact meat safety and quality (HUERTAS et al., 2010). Miranda de la Lama et al. (2012) consider that hematomas are indicators of pre-slaughter management failures, and may identify different problems, such as the persistent use of electric shocks or live corners, truck or driver problems, and batch mixing.

Studies in Uruguay describe that around 8 billion dollars annually are lost due to hematoma contusions (HUERTAS ET AL., 2015). Gallo and Huertas (2016) describe that in South America, interest in animal welfare is based more on economic issues related to the loss of quality and quantity of discarded meat (which cause a decrease in prices in the international market) rather than due to the protection of animal welfare.

Observing the economic losses due to bruising in carcasses is important so that all the links in the production chain can become aware of the need to adopt specific measures in relation to animal welfare practices, thus generating greater productivity, profitability, and

food safety, as these hematomas may develop to become sites of bacterial proliferation.

The objective of this study was to quantify the occurrence of hematomas in bovine carcasses and to determine their degree of severity in order to measure the economic impact caused by the hematomas.

## MATERIAL AND METHODS

This study was authorized by the Ethics Committee for Animal Use (CEUA) of the Pitágoras Unopar University under No. 0038.18 and carried out in a slaughterhouse located in the municipality of Ivaiporã, under the Paraná Inspection Service (SIP). The animals were evaluated only for the presence of bruises, without studying the effects of gender, age, and race, since the economic losses calculations were performed based on the weight of the lesions. The 385 animals were observed from the ten municipalities of the north central mesoregion of the state of Paraná. The mean transport distance of the animals per municipality is shown in Table 1.

Independent of the city, all trucks left the farm by gravel road and traveled partly along paved roads; however, to gain access to the slaughterhouse, there was a curve with a slope and approximately 2 km of the road was in a bad condition. These road conditions present nonconformities and anfractuosity, which in turn predisposed the cattle to traumas and falls.

The hematomas in the carcass were classified according to their severity: Grade I (GI) was assigned when there were only subcutaneous hematomas in the carcass, Grade II (GII) was given to those with hematomas that had reached muscle tissue, and Grade III (GIII) was assigned to those with hematomas that reached the bone tissue. When hematomas are present, removal of the affected area is performed, and aside from the injured tissue, adjacent tissue is also removed in order to create a safety margin that prevents any hematoma from being included in the meat. Because of this, the carcass weight is directly influenced, and greater losses were obtained with increasing severity (Figure 1).

Traumatized meat portions were properly identified, removed, deposited in plastic packages, and weighed using an electronic scale (Digi-tron®, weighing instruments, Model = UL DP, manufactured in 2000). The results were initially noted in a manual spreadsheet; after the end of the slaughter, the data were transferred to an Excel spreadsheet.

For calculating the losses obtained, the amounts paid by the slaughterhouse were used as a standard: U \$ 3.51 (R \$ 13.90) per kg of hind, U \$ 2.50 (R \$ 9.90) per kilo of ribs, and U \$ 1.99 (R \$ 7.90) per kg of front, with the exchange rate of the dollar (U \$) based on the exchange rate on May 12, 2019 (BACEN, 2019). Simple descriptive analysis was used for statistical analysis.

Table 1 - Distance traveled by the animals to the slaughterhouse and the number of animals slaughtered in each municipalities of the State of Paraná Distance (km) No. of animals slaughtered.

Municipalities of the State of Paraná	Distance (km)	Nº of animals slaughtered
A	21	3
B	34.2	3
C	88.8	8
D	14.9	3
E	10.7	28
F	4	262
G	22	2
H	30.2	25
I	43.1	28
J	72.8	23
Average	34,17	Total 385

Figure 1 - Bruises in bovine carcasses in Grade I, Grade II and Grade III.



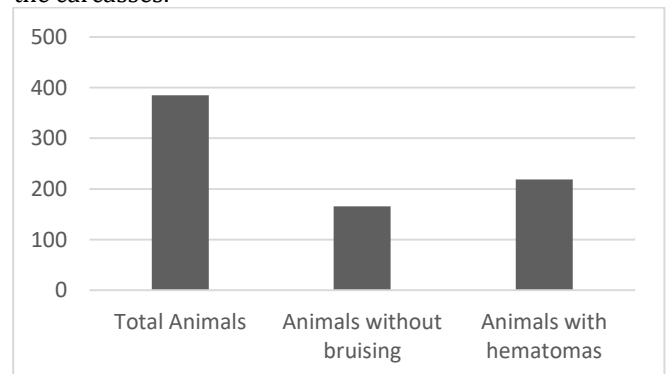
**RESULTS AND DISCUSSION**

Of the 385 animals, 219 (56.88%) presented one or more lesions in the carcass, totaling 427 lesions (Figure 2). Variations in the prevalence of carcass lesions may occur because of differences in methods used to diagnose and record hematomas (Huert et al., 2015). Using the method outlined by Frasão et al. (2014), 89.6% of animals were found to present lesions, whereas using the method of Mendonça et al. (2016) 66.10% of animals were found to have hematomas in their carcasses.

Among the evaluated animals, there was a total of 427 hematomas, or an average of 1.94 hematomas per animal. It is possible to compare these data with those reported by Petroni et al. (2013), who reported that in 898 animals, there were 3032 recorded bruises. Da Frasão et al. (2014) found 682 bruises in 320 carcasses, corroborating the findings of the present study that also detected more than one hematoma per carcass.

Mendonça et al. (2016) studied the carcass contusions in zebu and taurine animals and obtained a mean of 2.31 and 1.74 contusions per animal, respectively. In this study, there was no distinction of races.

Figure 2 - Graph representing the number of animals with hematoma and the number of hematomas found in the carcasses.



South American countries have a high incidence of bruising in cattle: Brazil with 89.06% incidence (FRASÃO et al., 2014), Uruguay with 60% (HUERTAS et al., 2015) and Colombia with 37.5% (ROMERO et al. 2013). The conviction of the affected parties follows the legislation enforced in each country (HOFFMAN; LÜHL., 2012). Some Latin American countries allow injured meat to be sent to industrial processing for human consumption in the domestic market; however, it is impossible to send these injured meats to international trade.

According to Grandin (2000), bruising may be related to transport and the handling of cattle by untrained personnel, who perform manipulations as if they were in battle against the animal and use rods and other objects to beat the animals. In addition, cowboys using guillotine-type doors that can hit the animals, as well as having narrow entrances, can also result in hemorrhages in the rear and front rooms.

Cruz-Monterrosa et al. (2016) report that bad driving habits, such as sudden acceleration and braking, have a great influence on the occurrence of bruises, especially when cattle fall inside the truck due to inappropriate driving. Consequently, other animals tread on them, causing bruising in a large part of the animal housing. The removal of the traumatized meat portions quantified a mean of 0.3 kg of meat discarded per carcass. These results are similar to the results described by Andrade et al. (2008), who obtained a mean of 0.31 kg of loss per carcass, but differ from the average described by Melo et al. (2015) where each carcass obtained a loss of 2.33 kg, which quantified a total loss of 1,143.8 kg in 490 animals.

The region most affected was the hindquarter, accounting for 54.49% of the present lesions, followed by the region near the ribs and the lumbar region, with 33.18% lesions, and the front quarter, with 12.32% lesions. The respective values in kilograms and dollars are shown in Table 2. These results are similar to the results reported by Petroni et al. (2013), which show that the frequency of lesions is higher in the hindquarter, intermediate near the ribs and the lumbar region, and lower in the fourth quarter.

The results obtained also present similarities to those of Andrade et al. (2008), Frasão et al. (2014), and Huertas et al. (2015), all of whom observed that there was a higher incidence of lesions and injury in the hindquarters of animals, which is of concern because this

region has noble cuts. The hindquarter contains the largest muscle mass, which predisposes this region to a greater number of hematomas (FRASÃO et al., 2014).

Huertas et al. (2015) conducted a survey in Uruguay, and described that the disposal done to the meats with hematoma results in their waste. When the destruction and loss of value are added, there is an estimated loss of 899 g of meat per slaughtered animal. The authors observed that the hindquarter was more affected (80.03%) than the front regions (6.02%).

On the contrary, Folitse et al. (2017) described hematomas in 16.76% (n = 21336) carcasses. The location of contusions shows that the forequarter was more affected (49.36%), followed by the loin (25.19%), hindquarter (13.11%), and ribs (6.94%).

In the work of Frasão et al. (2014), the authors describe that the type and condition of the road traveled, the number of stops, the speed of the truck, the travel time, and the specific capacity of the driver directly influence the formation of bruises. In the present study, the average distance traveled was 34 km, with the distances ranging from 4 to 88.8 km. The study did not evaluate the road conditions of the farms and the highway, but it was possible to observe the poor conditions of the road leading to the refrigerator. It is necessary that the drivers maintain awareness, otherwise, the fall of animals can occur, which consequently causes hematomas in the carcasses.

In a study by Folitse et al. (2017), the total weight of trimmed pieces was calculated to be 622.40 kg, with an estimated cost of US \$ 2,817.41 (R \$ 11,150.76) over the four-month study period. U \$ 125.73 (R \$ 497.62) was lost from the rear quarter, U \$ 54.53 (R \$ 215.82) was lost from near the ribs and the lumbar region, and U.S. \$ 26.40 (R \$ 104.49) was lost from the front quarter, resulting in a total loss of \$ 206.66 (\$ 817.93) as shown in Table 2. Our study showed a loss of 35.8 kg from the hindquarters, 21.8 kg from near the ribs and the lumbar region, and 8.1 kg from the front room, whereas Folitse et al. (2017) reported losses of 166.46 kg of trimmed meat from the forequarter, followed by the back (137.60 kg), hindquarter (129.60 kg), extremities (112.00 kg), and ribs (76.80 kg). Based on data from the slaughterhouse itself, an average of 7,200 animals are slaughtered per year, which leads to an estimated annual loss of U.S. \$ 6,767.39 (R \$ 26,784.00).

Table 2 – Occurrence of hematomas in carcasses by location and losses in Kilogram (Kg) and monetary values in US dollars (US \$) and real (US \$).

Injured region	Number of hematomas	Loss in kg	Loss in US\$	Loss in \$
Front room	35 (12.32%)	8.100	26.40	104.49
Lumbar region/ribs	144 (33.18%)	21.800	54.53	215.82
Rear room	248 (54.49%)	35.800	125.73	497.62
Total	427	65.700	206.66	817.93

Regarding the degree of hematoma, we observed that the majority of these were grade I (GI), that is, apparent only in the subcutaneous region, which influences the fat cover and the protection of the carcass against sharp drops in temperature due to the cooling process. The number of Grade I hematomas was 68.62% (n = 293), followed by GII with 28.8% (n = 123), and GIII with 2.58% (n = 11), as seen in Table 3.

The result in terms of the deep hematomas that reached the bone tissue was different from the observations of Frasão et al. (2014), whose study does not describe grade III lesions; however, their results obtained for GI, which was calculated to be 55.70%, are consistent with our study findings.

Table 3 – Occurrence of hematomas according to degree of involvement

Hematomas	Amount	%
Degree I	293	68.62
Degree II	123	28.80
Degree III	11	2.58
Total	427	100

Most of the bruising in the hindquarter was grade I (Table 4), which is consistent with the reports of Petroni et al. (2013), who observed the hindquarter as the most affected by grade 1 lesions. These phenomena are attributed to the fact that animals are handled with the employee positioned at the back or at the median of the animal in order to force the animal to move forward.

This can increase the occurrence of impacts and the improper use of equipment in the posterior region of the animal. In addition, the decrease in the frequency and severity (degrees) of hematomas according to the distance of the posterior region of the animal (Table 4) reinforces the possibility of the predominantly iatrogenic character of lesions in bovine carcasses.

Table 4 – Occurrence of lesions according to degree of severity and their location.

	Region 1	Region 2	Region 3	Total
Degree I	166	100	27	293
Degree II	67	41	15	123
Degree III	6	5	0	11

Region 1: rear quarter; Region 2: from the ribs to the lumbar region; Region 3: front room.

Grade I and II lesions are majorly responsible for the losses in terms of grams of meat removed by contusion (Table 5), which is consistent with Andrade et al. (2008), Frasão et al. (2014), and Huertas et al. (2015), whose

studies attributed the greatest economic losses to the higher frequency of lesions of different degrees in later years.

Table 5 – Average loss (in grams) of meat removed by contusion according to degree of injury and affected region of slaughtered animals

	Region 1	Region 2	Region 3	Total (g)
Degree I	16.400	10.000	4.700	31.100
Degree II	16.600	10.100	3.400	30.100
Degree III	2.800	1.700	0	4.500

Region 1: rear quarter; Region 2: from the ribs to the lumbar region; Region 3: front room.

When inadequate pre-slaughter management compromises animal welfare and carcass quality, the products depreciate in value in the international beef trade, which results in economic losses in domestic cattle breeding (PETRONI et al., 2013). It is worth noting that throughout the national territory, establishments slaughter thousands of animals per day, and improper handling by these establishments lead to losses of meat due to bruising in the carcasses, which, in turn, lead to negative economic impacts.

We conclude that the occurrence of hematoma lesions in bovine carcasses from the north central mesoregion of Paraná is responsible for economic losses.

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## CONCLUSION

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