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EVALUATION OF REACTIVITY AND STUNNING EFFICIENCY IN CATTLE BEFORE AND AFTER SLAUGHTERHOUSE STAFF TRAINING

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Abstract

The study aimed to evaluate the reactivity, as well as the efficacy of stunning in cattle before and after staff training at the slaughterhouse. For reactivity evaluation, vocalization, slips, falls, use of shockers and presence of lying animal were observed for handling in the corridor, bathing station and at the end of raceway in front of the stunning box. For stunning evaluation, shots applied to each animal to complete stunning and the distance between the shot site and the correct position for stunning were measured. Through mapping the main deficiencies and failures in each handling region, a training was elaborated focused on adoption of correct handling practices. After the informational lecture, data was collected again using the same procedures and in the same handling regions. After training, the quantification of all handling variables was considerably lower in the three regions of the pre-slaughter course, and there was a significant reduction in the bathing station and at the end of raceway in front of the stunning box (P<0.05). In addition, there was a significant increase in stunning performed at the correct shooting position and within 2 cm of the target (P<0.001), as well as reduction of shots applied outside of 3 cm (P<0.001). The number of shots required for complete stunning also decreased (P<0.05). Staff training was extremely efficient in reducing harmful variables to animal welfare and in increasing good practices in pre-slaughter handling.

Keywords

animal welfare, cerebral concussion, penetrating captive bolt gun, pre-slaughter.

AVALIAÇÃO DA REATIVIDADE E INSENSIBILIZAÇÃO EM BOVINOS ANTES E APÓS O TREINAMENTO DE FUNCIONÁRIOS EM ABATEDOURO FRIGORÍFICO

Resumo

O trabalho teve por objetivo avaliar a reatividade e aferir a eficiência de insensibilização em bovinos antes e após o treinamento de funcionários em abatedouro frigorífico. Foi observado o manejo no corredor, chuveiro e brete, sendo analisado: vocalização, escorregão, queda, uso de choque e presença de animal deitado. Foram quantificados os disparos necessários para que houvesse o atordoamento de cada animal e mensuração da distância compreendida entre o ponto do disparo efetuado e o local ideal para insensibilização. Através do mapeamento das principais deficiências e falhas de manejo em cada região, foi elaborado uma palestra com foco na adoção de manejos e práticas ideais no pré-abate. Após a palestra informativa, efetuou-se novamente a coleta de dados. Após o treinamento a quantificação de todas as variáveis de manejo foi consideravelmente inferior nas três regiões do percurso pré-abate, e houve redução nas regiões chuveiro e brete (P<0,05). Além disso, houve aumento na insensibilização efetuada no ponto ideal à até 2 cm da mesma (P<0,001), bem como redução de disparos efetuados acima de 3 cm de distância (P<0,001). A quantidade de disparos necessários para completo atordoamento também apresentou redução (P<0,005). O treinamento aos funcionários foi extremamente eficiente na redução de variáveis prejudicais ao bem-estar animal e no incremento de boas práticas no manejo pré-abate.

Palavras-chave

bem-estar animal, concussão cerebral, dardo cativo penetrante, pré-abate.

INTRODUCTION

In order to meet consumer demands and improve the quality of products from animal origin, production systems have been increasingly intensified. However, when purchasing animal-based products aspects in addition to product quality must be considered. Actions related to ethical consumption, especially in more developed countries of which some are buyers of Brazilian meat, this issue have been constantly evaluated by the population (FRANCHI et al., 2012).

From an economic point of view, this humanitarian treatment is also related to increased productivity because it is known that the reduction of stress in the pre-slaughter period generates a lower mortality rate among animals, improves the quality of meat and reduces damage to it. This results in fewer losses during the process and greater value attributed to the product (LUCHIARI FILHO, 2000).

In the scope of obtaining quality products through rational management, there is a convergence with regards to excess aggressiveness in the pre-slaughter handling caused within the slaughterhouse. According to Peñuela et al. (2011), this is justified by the fact that the treatment offered to cattle is often defined by punitive procedures, routinely encountering unnecessary and excessive aggression, which is observed by excessive vocalizations, slips and falls in pre-slaughter management.

However, with all issues related to humanitarian handling and slaughter, stunning must also be carefully considered. This stage comprises the process which makes the animal unconscious, so that the bleeding process does not cause pain or distress, with the objective of minimizing suffering prior to death (GRANDIN, 1997). Also, according to the author, the main causes of failures in the stunning process are related to the lack of equipment maintenance, and fatigue of employees who fail to shoot at the recommended location on the animal's head.

The knowledge on cattle temperament has great importance, since more reactive animals may show extreme reactions when handled, resulting in negative responses on the part of the handlers which can aggravate their pre-slaughter well-being (COLEMAN and HEMSWORTH, 2014). Thus, it is believed that hostile behavior on the part of the employees may be a factor resulting from their lack of training regarding the senses and behavior of cattle.

In order to improve the handling techniques applied by employees towards

animals, technical training and adaptation to the welfare requirements of cattle are strategies for changing the attitudes of handlers towards animals, since this minimizes unnecessary aggression (RUSSI et al., 2011). Thus, evaluation of the animals' behavior when handled in the pre-slaughter phase can be used as an indication of the quality of handling, just as the stunning efficiency is an indicator of problems in well-being.

Therefore, the objective of the present study was to evaluate the reactivity and efficiency of cattle stunning before and after training employees in a slaughterhouse.

MATERIAL AND METHODS

The study was carried out in a slaughterhouse inspected by the Federal Inspection System (*Sistema de Inspeção Federal* - SIF) located at Mato Grosso do Sul State, Brazil during the period between August 2016 and February 2017. Management assessments were carried out on different days, quantifying the incidence of slips, falls, vocalizations, shock usage and number of animals lying down on the pre-slaughter route, which represent indicators of management efficiency.

The evaluation of these variables followed the methodology defined by Grandin (2001), considering vocalization characterized by each and every audible sound emitted by the animal in a situation of pain or physical discomfort; slips as an imbalance of the animal due to an involuntary displacement of the limbs, without actually falling to the ground; falls when the animal reached the decubitus position involuntarily; shocker use was assessed by touching the electric shocker to the animal's body surface; and finally the number of animals lying down was characterized by the presence of a lying animal, either spontaneously or forced, on the pre-slaughter route.

Each subdivision of the pre-slaughter route was defined as a corridor, bathing station and end of raceway in front of the stunning box. The corridor corresponding to the first portion of the path taken by the animals after leaving the waiting corral; the bathing station comprised the portion where the water spray bath actually occurs; and the raceway as the individual corridor preceding the stunning box. Observations were conducted by a properly trained team, so that the assessment was as descriptive as possible.

For the assessment of stunning two parameters were evaluated. First, the number of shots necessary for each animal to be stunned and, second referring to the distance measured between the point of the shot made and the ideal location for

stunning. For the first, all the times that the pneumatic pistol was activated (firing) were counted until the animal was completely numb (absence of movements, decubitus position and unconsciousness). For the second parameter, a transparent plastic in the shape of a "target" was used, containing circles drawn measuring 2, 4, 6, 8, 10, 12, 14 and 16 cm in diameter, which was superimposed on the skull of the animal immediately after disarticulation of the head, just above the line of the eyes, thus identifying the distance in centimeters (1, 2, 3, 4, 5, 6, 7 or 8 cm) between the location of the shot and the ideal point for stunning (point at the center of the 2 cm diameter circle), according to the methodology of Gallo et al. (2003) (Figure 1). The ideal stun position was defined as the intersecting point of imaginary lines drawn between the base of each horn and the corner of the eye on the opposite side of the head (LUDTKE et al., 2012).
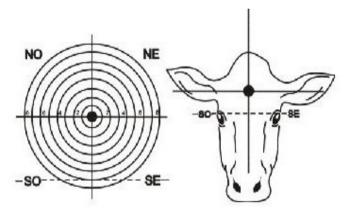

Figure 1. Transparent plastic target and its position on the animal's skull (Source: Gallo et al., 2003)

For evaluation before training 1.135 animals were observed, with 955 castrated males and 180 females selected at random. In order to assess the stunning efficiency, 268 animals were used, not differentiated by gender .

When analyzing the data prior to training through the observations previously described (slips, falls, vocalization, use of shock and number of animals), it was possible to note the main deficiencies and handling failures in each pre-established region. This allowed the development of a lecture and training session focused on the adoption of handling practices that would minimize losses associated with the activities.

At the time of the lecture, all staff involved in pre-slaughter handling and stunning were gathered together, informing them—the data collected during the evaluation period so they could also notice the handling flaws and deficiencies. In addition, they were instructed on the sensory physiology of cattle, animal welfare

within slaughterhouse facilities, prohibited and permitted places for the use of electric shockers, notions and techniques of rational handling and the importance of correct stunning. Information leaflets were also created and distributed among employees, as a form of auxiliary material.

After the informative lecture the second data collection was carried out. The same procedures and the same regions of the pre-slaughter route in the slaughterhouse were used in order to assess the level of efficiency achieved with the training, observing the incidence of the variables under study in the day-to-day handling after training.

For this last handling evaluation, 1171 cattle were used, chosen at random, consisting of 525 castrated males and 646 females. In order to assess the efficiency of stunning, 260 animals were evaluated.

The data was analyzed to evaluate the effect of training in the slaughterhouse on the frequency of occurrences of each behavior in each gender (since the data samples were formed according to the animal gender). The "tables" command was used with the "relrisk" option in the PROC FREQ procedure of SAS University (SAS Institute Inc., Cary, CA, USA). Variations in the frequency of occurrence of the behaviors were then compared by a bilateral Z-test at the 5% significance level, using the WALD method.

Initially, all data obtained in the slaughterhouse were analyzed such as the effect of training on most of the evaluated behaviors, the effects of training on the animals' behavior at each location of the pre-slaughter route assessed (corridor, bathing station and raceway). A significance level of 5% was adopted for all analyses. In addition, the mean was used to obtain data on the occurrence of shocker usage (total shock delivered ÷ number of animals = average of shocks per animal).

RESULTS AND DISCUSSION

The occurrence of vocalizations before training was observed 29 times in the corridor region, 91 in the bathing region and another 733 occurrences in the raceway (the total frequency in 1135 animals not differentiated by sex), which corresponds to percentages of 2.55, 8.02 and 64.59%, respectively (Table 1). When analyzing the frequency by gender, there was no difference before and after training for vocalization in the corridor region, however there was ($P = 0.026$) for females in the bathing area.

The reactivity of animals, according to Haskell et al. (2014), is assessed through reactions to stimuli caused by human presence. According to Grandin (2000a), the reaction intensity is dependent on factors such as sounds, places and sights, which

Table 1. Total occurrences of vocalizations, slips, falls, presence of lying animal and use of shockers in the three regions of pre-slaughter cattle handling, differentiated by sex and assessments before and after staff training in a slaughterhouse

Region	Behavior	Sex	Occurrences		P-Value[1]	Difference before and after training (%)
			Before Training	After Training[3]		
Corridor	Vocalization	M	25	6	0.455	1.47
		F	4	12	0.857	0.36
	Slips	M	41	0	n.o.*	4.29
		F	9	0	n.o.*	5.00
	Falls	M	17	2	0.386	1.40
		F	7	1	0.215	3.73
	Shocker use	M	152	62	0.403	4.11
		F	27	105	0.808	-1.25
	Lying down	M	6	2	0.805	0.25
		F	1	0	n.o.*	0.56
	Total Behaviors	M	241	72	0.045	11.52
		F	48	118	0.159	8.40
Bathing	Vocalization	M	71	0	n.o.*	7.43
		F	20	4	0.026	10.49
	Slips	M	6	0	n.o.*	0.63
		F	0	0	n.o.*	0.00
	Falls	M	12	3	0.618	0.69
		F	4	6	0.478	1.29
	Shocker use	M	918	189	<0.001	60.13
		F	229	153	<0.001	103.54
	Lying down	M	72	31	0.644	1.63
		F	9	19	0.461	2.06
	Total Behaviors	M	1.079	223	<0.001	70.51
		F	262	182	<0.001	117.38
Raceway	Vocalization	M	575	157	<0.001	30.30
		F	158	323	<0.001	37.78
	Slips	M	381	44	<0.001	31.51
		F	82	65	<0.001	35.49
	Falls	M	202	31	0.004	15.25
		F	38	53	0.014	12.91
	Shocker use	M	6.247	1.161	<0.001	432.99
		F	1.397	1.534	<0.001	538.65
	Lying down	M	128	42	0.224	5.40
		F	30	52	0.072	8.62
	Total Behaviors	M	7.533	1.435	0.002	515.46
		F	1.705	2.027	0.005	633.45

*n.o.: not observed; [1]Bilaterial Z test at 5% significance; [2]Data referring to evaluation of 955 castrated males (M) and 180 females (F); [3]Data referring to the evaluation of 525 castrated males (M) and 646 females (F)

serve as inducers of warning signals when animals are faced with the unknown. Grandin (2000b) defines an acceptable level of 3% or fewer vocalization during the conduction of animals in pre-slaughter management. Therefore, vocalization levels in the corridor (although not significant) are within acceptable limits before training.

In the raceway, because it precedes the stunning box, a region in which the animals are more apprehensive, the vocalization values decreased (P <0.05) in both males and females, however, they still remained high when considering all animals evaluated (40.99% of vocalizations).

Grandin (2000b) affirmed that in suitable facilities falls should not occur in more than 1% of animals and slips should be less than 3%. It is noted that before training, the numbers of slips and falls in the raceway region were extremely high (463 slips and 240 falls in 1135 animals not differentiated by sex, which represents 40.80% of the herd in slip conditions and 21.14% in a fall situation). This indicates failures in handling, since the entire route consisted of a non-slip floor so slips and falls could not be attributed to a deficient installation. Thus, stratification by sex class was significant in the raceway for falls and slips when evaluating the effects of training, demonstrating its efficiency and importance among employees. The same was not observed in the corridor and bathing areas (P>0.05).

The presence of animals lying down, like all other variables, was numerically greater in the raceway region (158 versus 7 in the corridor area and 81 in the bathing area, among 1135 animals not differentiated by sex). Because this is an individualized and narrow space, the presence of a lying animal probably implies trampling, directly influencing the quality of the carcass and meat, in addition to allowing the animal to suffer. Despite showing an improvement in the numbers after training, there was no difference (P>0.05) for this variable in any region.

In general, animals that are more reactive or excitable may present a greater number of slips, falls and a higher incidence of shock use due to the difficulty in handling them, and consequently greater vocalization (BERTOLINI et al., 2012). After training of the staff, several of these rates were significantly reduced, showing the efficiency of their use when rational handling methods are used to raise employee awareness.

It is known that stress, among other factors, is attributed to increased blood concentration of the cortisol hormone. Its variation is related to the different responses of the animals in the face of various handling situations to which they are submitted (PIGHIN et al., 2015), sometimes independent of gender. In this sense, Probst et al. (2014) found a higher serum concentration of cortisol in heifers when compared to bulls and steers subjected to pre-slaughter stress (electric shock and length of stay in the

stunning box), indicating that females are more reactive than males. On the other hand, Bonilha et al. (2015) found higher cortisol levels in males in comparison to females.
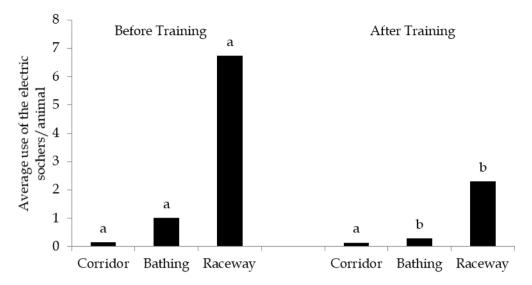
Regarding the use of shockers, there was a reduction (P<0.001) in the bathing and raceway regions, regardless of sex class (Figure 2) and for both males and females (Figure 3). Before the training, it can be observed that the animals suffered approximately 7 shocks on average in the total pre-slaughter route. After training this value dropped to 2 shocks/animal on the same route. Regardless of training, the use of shockers in the corridor and bathing regions was considerably lower than in the raceway region. This is because as the animals get closer to the stunning box, where the animals are lined up, handling intensifies in comparison to the corridor and bathing areas which are more spacious. In these areas it is possible to conduct groups of animals in a progressive march, avoiding that they are excessively stimulated, different from what occurs in the raceway region.

The use of shockers accompanies higher vocalization values, because the increase in their use consequently generates greater pain or physical discomfort. According to Grandin (1997), the high incidence of vocalizations indicates situations of extreme handling and/or high reactivity of the animals.
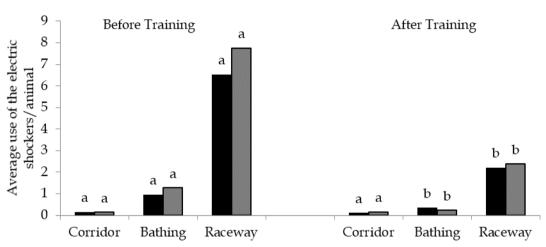
When evaluating the stunning of the animals, a greater number of shots were taken before the employees were trained (P<0.05) (Table 2). According to Grandin (2000b), the occurrence of immediate collapse after only one use of the captive bolt gun is considered excellent, while fewer than 90% of animals stunned with only one shot is considered unacceptable.

It was noted that before training only 22.39% of the animals were desensitized with just one shot, and the vast majority needed at least two (46.27%) or three (26.49%) for complete stunning. There were also situations of using up to four and/or five shots per animal. After training, there was an increase (P<0.001) in the percentage of animals stunned with just one shot, increasing from 22.39% to 80.77%, and a consequent reduction, also significant, in the number of animals stunned with the use two or three shots, in addition to the fact that there was no occurrence of animals stunned with more than three shots.

The number of shots necessary for the complete stunning of the animals was different before and after staff training (Table 3). In summary, stunning is considered the most critical step in the slaughter of cattle, where the main objective is to promote

Figure 2. Average of Shocker fired/animal in different regions of the pre-slaughter route, before and after staff training in a slaughterhouse. The different letters within the same region indicate that there was a statistical difference between the means after training at 5% significance by the Bilateral Z test.

Figure 3. Average shocker used in castrated males and females in the regions of the pre-slaughter route, before and after staff training in a slaughterhouse. The different letters within the same region for the same sex class indicate that there was a statistical difference between the means after training at 5% significance by the Bilateral Z test.

Table 2. Percentage of animals stunned by the number of shots fired and frequency (freq.) of the number of shots, before and after staff training in a slaughterhouse

Training	Shots (nº)									
	1		2		3		4		5	
	%	freq.	%	freq.	%	freq.	%	freq.	%	freq.
Before	22.39	60	46.27	124	26.49	71	3.36	9	1.49	4
After	80.77	210	18.08	47	1.15	3	0.00	0	0.00	0
P-value[1]	<0.001		0.0026		<0.001		n.o.*		n.o.*	

*n.o.: not observed
[1]Bilateral Z test at 5% significance

Table 3. Number of shots necessary for complete stunning of the animals and average number of shots/ animal, before and after staff training in a slaughterhouse

Training	Animals stunned	Number of shots	Average shots/animal
Before	268	577	2.15
After	260	313	1.20
P-value [1]		<0.001	

[1]Bilateral Z test at 5% significance

rapid unconsciousness, maintaining vital functions until bleeding. It also allows the animals to be bled without feeling pain or distress; in this sense the average number of shots should not exceed one (GIBSON et al., 2015). For this, the captive bolt gun has been the most used method in Brazil for stunning cattle, which consists of a strong impact to and perforation of the skull, causing an immediate brain collapse capable of deeply stunning the animal. In this context, despite reducing the number of shots to almost one per animal in the present study the value still remained high after training, since according to Grandin (2000b) and Gibson et al. (2015) it should be limited to just one shot, thus ensuring the provision of well-being.

Furthermore, the ideal stunning point and the distances between the shooting location and the ideal point for stunning were evaluated (Table 4). According to the Humane Slaughter Association (1998), if penetration of the captive bolt is between 4 and 6 cm from the ideal location, the effectiveness of the shot reaches only 60%. According to Gregory et al. (2007), when the firing position is more than 2 cm away from the ideal location, the risk of poor stunning is increased or there is an increased risk of the animal regaining consciousness sooner. In this study, before training only 11.38% of shots were on target, and a high percentage of stunning (65.86%) occurred between 2 and 4 cm away from the ideal location. After training, the number of accurate shots increased by more than 10% (P<0.001), and there was an increase

Table 4. Number of shots (%) taken at 1, 2, 3, 4, 5, 6, 7 and 8 cm away from the ideal target for stunning and shots taken at the ideal location for stunning (Hit), before and after staff training in a slaughterhouse

Training	Distance from target (cm)								
	1	2	3	4	5	6	7	8	Hits
Before	14.09	26.29	24.39	15.18	5.42	2.44	0.81	0	11.38
After	21.6	29.97	16.72	4.88	6.97	0.7	0	0	19.16
P-value [1]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n.o.[*]	n.o.[*]	<0.001

*n.o.: not observed
[1]Bilateral Z test at 5% significance

(P<0.001) in the percentage of shots between 1 and 2 cm away from the ideal location. This indicates that most of the stunning errors occurred at a distance smaller than that observed before training. In addition, there was a significant reduction in the number of shots located at 3, 4, 5 and 6 cm from the target (P<0.001), and none further than 6 cm.

CONCLUSIONS

The evaluation of post-training handling was satisfactory in several regions of the waiting corral, since there was a reduction in vocalizations, slips, falls, the presence of an animal lying down and the use of shockers.

Training of staff positively influenced the reduction in number of shots necessary for complete stunning, and also reduced the distance between the ideal stunning point and the region where the shot was actually applied.

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