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Condemnation of pork carcasses by cannibalism in slaughterhouse from Northern Mesoregion Mato-grossense, Brazil

Condenações de carcaças suínas por canibalismo em frigorífico de abate na mesorregião norte Mato-grossense, Brasil

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ABSTRACT: Among the disturbances resulting from stress is cannibalism, in the confinement of swines, it is caused by suffering environmental disturbances. Therefore, the aimed of this study was to analyze the rates of condemnation of swine carcasses for cannibalism in the period from January to April 2020 in a slaughterhouse located in the Northern Mesoregion Mato-grossense - Brazil. Data were conducted using ANOVA and Tukey Test (α=0.05). The study of proportions was also carried out as a statistical basis to calculate the percentage of destinations and the total amount of condemned swine carcasses. The averages of the condemned, released and used carcasses show a statistical difference ($p<0.05$) between the months studied. The monthly averages were 112.25 condemned carcasses (64.25 released, 35 used conditionally and 13 destined for rendering). In the total of carcasses condemned for cannibalism, there were values of 57.28% for release, 31.18% for conditional use and 11.58% for rendering, with a higher incidence in March. The incidence of cannibalism can be considered low in relation to the number of animals slaughtered in a four-month period. However, the economic impact must be taken into account, because the loss due to total conviction and conditional use cause significant financial losses. In addition, uncomfortable production environments have factors closely related to cannibalism, being difficult to control after the outbreak begins. Therefore, the incidence of cannibalism can influence the final carcass yield of swines slaughtered in the finishing phase.

KEYWORDS: Animal welfare; Anomalous behavior; Environmental stress; Meat quality.

RESUMO: Dentre os distúrbios decorrentes do estresse está o canibalismo, no confinamento de suínos se dá por sofrer distúrbios ambientais. Diante disso, o objetivo desse estudo foi analisar os índices de condenação de carcaças suínas por canibalismo no período de janeiro a abril de 2020 em um frigorífico de abate localizado na Mesorregião Norte Mato-Grossense - Brasil. Os dados foram conduzidos à ANOVA e pelo Teste de Tukey (α=0,05). Foi realizado também, o estudo de proporções como base estatística para calcular a porcentagem das destinações e da quantidade total de carcaças suínas condenadas. As médias das carcaças condenadas, liberadas e aproveitadas apresentam diferença estatística ($p<0,05$) entre os meses estudados. Sendo as médias mensais 112,25 carcaças condenadas, (64,25 liberação, 35 aproveitadas condicionalmente e 13 destinadas para a graxaria). No total de carcaças condenadas por canibalismo, constatou-se valores de 57,28% para liberação, 31,18% destinadas a aproveitamento condicional e 11,58% destinadas à graxaria, onde se observou maior incidência no mês de março. A incidência de canibalismo pode ser considerada baixa em relação a quantidade de animais abatidos em um período de quatro meses. Contudo, o impacto econômico deve ser levado em consideração, porque a perda por condenação total e por aproveitamento condicional provocam prejuízos financeiros significativos. Além disso, os ambientes de produção desconfortáveis apresentam fatores intimamente relacionados ao canibalismo, sendo de difícil controle após o início do surto. Portanto, a incidência de canibalismo pode influenciar no rendimento final da carcaça de suínos abatidos em fase de terminação.

PALAVRAS-CHAVE: Bem-estar animal; Estresse ambiental; Comportamento anômalo; Qualidade da carne.

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INTRODUCTION

The swine (*Sus scrofa domesticus*) is a domesticated mammal that comes from the origin of the wild boar (*Sus scrofa*), and today it has become one of the most confined mammals in the world (COLDITZ; HINE, 2016). Its domestication took place through the first human settlements that began to develop agriculture and produce grains, and the domestication of feral swines that a few years later became one of the main activities of humanity (FERREIRA et al., 2014). Pork meat has been present in the human diet for many centuries, because it is a food that has many nutrients such as proteins, minerals and vitamins that are essential to human health and well-being (FAO, 2018).

Currently, China is the largest pork producer in the world, accounting for 41.72% of the production on the international market. Next, the largest producers are the European Union (~23%), United States of America (~12%) and Brazil (~4%). With regard to exports, the European Union occupies the first position (3,551 tons), followed by the United States of America (2,847 tons), Canada (1,284 tons) and Brazil (750 tons) (ABPA, 2020). Therefore, Brazil is the fourth largest pork producer and exporter in the world. And, according to the Confederation of Agriculture and Livestock of Brazil (CNA,), the country produced approximately 37 million swines heads in the 2014/15 harvest (ZANELLA et al., 2016).

It is worth remembering that at the beginning of the development of the swine production chain in Brazil, there were several obstacles, because the activity was aimed at the production of swine fat for subsistence of traditional populations, and it became intensive only from 1960 (GUANZIROLI et al., 2013). Even with this change, Brazilian swine farming has suffered problems with African Swine Fever (PSA). This health problem caused delays in the development of the activity in relation to other countries (ZEN et al., 2014). However, over the years steps have been taken for sanitary solutions. However, with the increase in production, concern with slaughter methods has also increased, that is, with animal welfare (HARLEY et al., 2012).

According to the World Organization for Animal Health (OIE), the animal must be healthy, well nourished, and in a comfortable, safe environment that is capable of expressing its natural behavior. The behavior of swines is linked to the environment in which they live, which in intensive production must be adapted (COLDITZ; HINE, 2016). Swines, although confined to production systems, have an exploratory instinct, so they spend a good deal of time exploring the breeding environment, looking for food even though their food is provided by man (MACHADO et al., 2017). However, the environment in which they live in industrial production generates major behavioral changes, mainly related to stress, which can result in serious problems in swine production (MAIA, et al., 2013). One of the ways that swines show a state of stress is cannibalism (MARQUES et al., 2012), in which it is anomalous behavior whose cause is due to environmental adversities, such as an environment without stress reducers, temperature and climate that is not ideal for age and species of the animal, in addition to high density inside the pens and inadequate handling (LUDTKE et al., 2012; VELONI et al., 2013).

Industrial swine farming is the most explored area of this commercial category, where high investments in technologies are applied due to the concern with animal welfare (HARLEY et al., 2012). This concern of the sector is one of the main virtues of the production system, aiming at greater weight gain and better meat quality. The harms such as the loss of yield in the production of sausages, and the reduction of the shelf life of the product are caused due to the changes that occur in the meat after slaughter. Therefore, it is essential to know methods that avoid environmental stress in the production system. The production of the state of Mato Grosso is equivalent to 6.71% of the total Brazilian production (ABPA, 2020), with the northern region of Mato Grosso with 72.8% of the state's herd (ANUNCIATO; PAES, 2016). Thus, it is important to gather information on the situation of pork, as it is one of the regions with the highest pork production in the Amazon. For this, it is necessary to carry out a study of the impacts caused on the quality of the region's meat and the management methods adopted to avoid changes in the carcass.

Given the assumptions, the aimed of this study was to analyze the rates of condemnation of swines carcasses for cannibalism in the period from January to April 2020 in a slaughterhouse under Federal Inspection (SIF) located in the Northern Mesoregion Mato-Grossense - Brazil.

MATERIAL AND METHODS

The study was conducted by analyzing data from a pork slaughterhouse under the Federal Inspection System (SIF), located in the Northern Mesoregion of the state of Mato Grosso, Brazil. It is worth mentioning that the abovementioned slaughterhouse meets the demands for pork in the North Mato Grosso region (SOUZA, 2020).

As this is a data analysis study, it was not necessary to submit the research to the Ethics Committee on the Use of Animals (CEUA). However, ethical principles were respected in the research. Additionally, at the request of the company that granted the data, the municipality in which the slaughterhouse is located was omitted, indicating only the region in which the slaughterhouse is located and the production flows, the Northern Mesoregion Mato-Grossense.

It is worth mentioning that the variation in the incidence of condemnations during the study period was analyzed, since the proportions study showed the percentage of condemnations for cannibalism in a total of animals slaughtered in the first four months of 2020. About 0.10% of the carcasses were condemned for cannibalism, with 0.06% released for consumption, 0.032% for conditional use and 0.012% for grease.

The data were arranged in electronic spreadsheets and transferred for statistical analysis in the Action Stat 3.7 software.

First, the data were conducted to ANOVA and then the Tukey Test (α=0.05) was used as a statistical basis to obtain contrast between the averages of each specific destination (release, conditional use and grease). As well as, the total of carcasses condemned for cannibalism among the total number of animals slaughtered during the months of January to April 2020.

The study of proportions of two samples was also carried out as a statistical basis to calculate the percentage of each destination and the total amount of swine carcasses condemned for cannibalism, considering the total number of animals slaughtered during the months of January to April of the year 2020. To carry out the calculation of economic losses, the following formula was used: Economic loss = PMC x 72% yield x VMCS x total carcasses destined for grease. Where PMC stands for Average Carcass Weight; VMCS Means Average Value of Pork in the period of the 4 months of the survey.

RESULTS

Carcass condemnation data for cannibalism between the months of January to April of the year 2020 were analyzed (Table 1), this was the period of slaughtering of swines from the aforementioned slaughterhouse. The data were collected about the destination of the condemnations of the pork carcasses, aiming to evaluate the impact of the destination in the carcass yield and in its final weight, respectively.

The total number of condemnations, releases and conditional use of pork carcasses for cannibalism each month was evaluated between January and April of 2020, and their respective destinations. The results obtained in the study and analyzed by the Tukey Test (α=0.05) show that the averages of the condemned, released and used carcasses show a statistical difference ($p<0.05$) between the months studied (Table 2). With the monthly averages, 112.25 condemned carcasses, 64.25 carcasses destined for release, 35 destined for conditional use and 13 destined for grease (Table 3).

The study of proportions showed the percentage of condemnations for cannibalism in a total of animals slaughtered in the first four months of the year 2020, about 0.10% of the carcasses were condemned for cannibalism, with 0.06% being released for consumption, 0.032% are destined for conditional use and 0.012% were destined for grease (Table 3).

Table 1. Number of pigs slaughtered in the period from January to April 2020 in the slaughterhouse located in the Northern Mesoregion Mato-Grossense.

Animal slaughter months	Number of slaughtered pigs
January	110,935
February	99,047
March	112,556
April	104,570
Total pigs slaughtered	427,108

Within the total of carcasses condemned for cannibalism, it was found that 57.28% (257 carcasses) were destined for release, 31.18% (140 carcasses) destined for conditional use and 11.58% (52) destined for grease (Figure 1).

Table 2. Carcass condemnations averages for cannibalism from January to April 2020 from slaughterhouse located in the Northern Mesoregion Mato-Grossense.

Slaughter months	Condemnations	Releases	Conditional use	Grease
January	104 ab	49 ab	42 a	13 a
February	98 ab	52 ab	32 ab	14 a
March	158 a	119 a	28 ab	11 ab
April	89 ab	37 b	38 a	14 a
C.V. (%)[1]	10.88	8.70	8.85	9.00
Average Total	449	257	140	52

If there are averages followed by different letters (a, b) between the lines, they are different by the Tukey ANOVA test (α=0.05). [1] Coefficient of variation.

Table 3. Results of the study of proportions for the destinations of the pork carcasses from slaughterhouse located in the Northern Mesoregion Mato-Grossense.

Destinations	Sample average	Sample proportion
Releases	64.25	0.00060172
Conditional use	35.00	0.000327786
Grease	13.00	0.00012175
Total	112.25	0.001051256

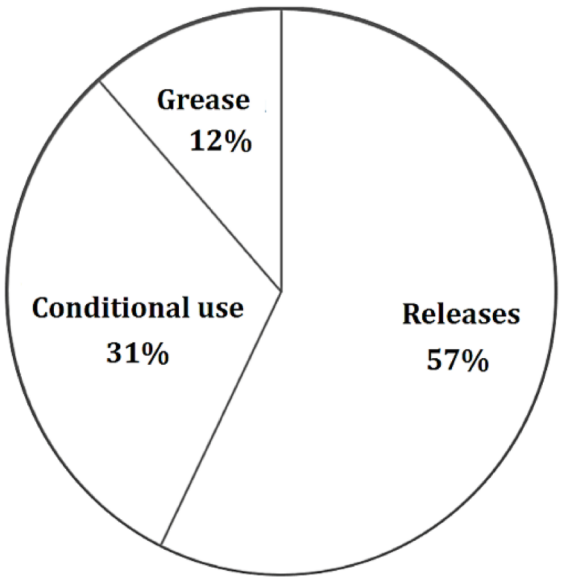

Figure 1. Values of destinations on the total of condemnations of pig carcasses from January to April 2020 in the slaughterhouse located in the Northern Mesoregion Mato-Grossense.

The variation in the incidence of condemnations during the study period was analyzed, from January to April of the year 2020, where the highest incidence was observed in March, and the lowest in April (Figure 2).

DISCUSSION

Vill (2019) carried out a study on a refrigeration plant in the Western region of the state of Santa Catarina - Brazil, where 181,295 animals were slaughtered in 3 months, obtaining an average of 0.40% of caudophagy kidnappings on the total slaughtered. Average higher than in this study, which obtained 0.10% kidnapped by cannibalism in relation to the total number of slaughtered animals. However, in this study, more animals were slaughtered and the analysis period was four months. However, Cordeiro (2017), in a survey conducted in a refrigeration unit located in the Central region of the state of Santa Catarina, reported the main condemnations during the period from March to May 2017, where cannibalism condemnations reached 0.003% for use conditional and 0.002% for grease in a total of 296,346 slaughtered carcasses, however, there was no destination for the release of carcasses affected by cannibalism. In other words, the results obtained in this study were more critical in relation to the results found by Cordeiro (2017), because the percentage of animals affected by cannibalism destined for release was 0.06%, for conditional use were 0.032%, and for grease was 0.012%. However, a larger number of animals were slaughtered and data analyzed for a longer period.

In the study by Vill (2019), therefore, there was a gradual decline in cases of cannibalism between the final months of study, that is, termination. Where the first month (August) had an average higher than the last month (October), which did not occur in the current survey, because there was a lot of variation during the months, noting the greater and lesser incidence of cannibalism in the third month of study, respectively. According to Article 111 of RIISPOA (BRASIL, 2017),

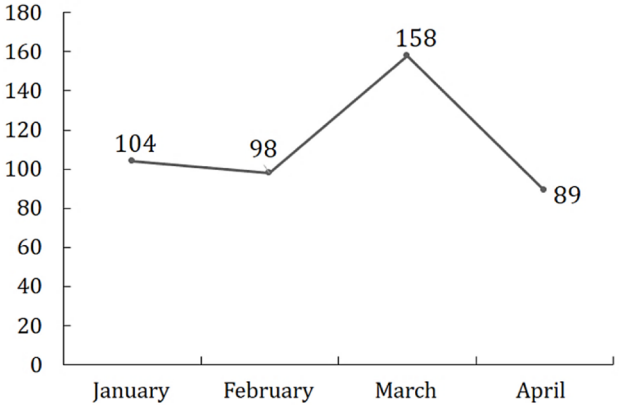

Figure 2. Incidence of cannibalism from January to April 2020 in the slaughterhouse located in the Northern Mesoregion Mato-Grossense.

carcasses from animals slaughtered emergency and that have not been condemned to grease, can be released for direct consumption if there is no health compromise or destined for conditional use, which is in accordance with the research in question. Carcasses that have deeper lesions are intended for conditional use of heat by cooking at 76.6 ° C for 30 minutes as established by law.

Crippa (2010), in a study conducted in the Central region of the state of Rio Grande do Sul - Brazil, the author argues that the longer the waiting time in the arrival and selection bays of the refrigerator, the greater the risk of skin lesions related to fights and mixing of lots, which are stressful factors for the animal and, thus, increases the risk of changes in the quality of the meat, such as the occurrence of PSE (Pale, Soft and Exudative) meat, which causes negative impacts both on the meat *in natura* and in the processing of sausages. According to Art. 324 of RIISPOA (BRASIL, 2017), all products that are totally condemned must be cooked in the non-edible products section, and their passage through the area for handling edible products is prohibited. In this research 52 carcasses were destined for inedible grease at a temperature of 400° C, respecting the guidelines of the current legislation.

Braga et al. (2006), carried out a study in a slaughterhouse in the municipality of Concórdia, in the state of Santa Catarina - Brazil, discussed the percentage of condemnations for caudophagy, although it is not very expressive, it is relevant because when affected by this injury, the carcass must be doomed. In this research, 449 carcasses were condemned, representing 0.10% of the total slaughtered, with 52 carcasses (0.012%) totally condemned in live weighs an average of 100kg with an average carcass yield of 72%, pork carcasses weigh an average of 72kg, which means a loss of R $ 573.12 per carcass and R $ 29,802.24 in the total of carcasses that were destined for grease edible. Associated with economic losses are losses in meat quality, due to stressful conditions that the animal is exposed to, resulting in losses mainly in the production of processed products (SOUZA, 2020). However, when associated with the farm, losses by animals discarded by extensive cannibalism injuries must be considered.

According to the research carried out by Giovanini et al. (2014) in a slaughterhouse in the state of São Paulo - Brazil, in this research the main cause of osteomyelitis was caused by tail cannibalism, causing secondary bacterial infection and local or multifocal abscesses associated with cannibalism. Thus, the number of condemned carcasses related to cannibalism may be higher than reported at study. Being related to well-being, caudophagy is a behavioral pathology that can be linked to a lack of harmony in the squad, the injury affects the region of the muscles and spine, being able to cause abscesses in these tissues and even infection in the spine (MORÉS et al., 2016; CORDEIRO, 2017). According to Marques (2010), in swine finishing farms in the Central region of Rio Grande do Sul - Brazil, caudophagy injuries may not be observed at

slaughter and the carcass may be condemned for another reason by the inspection service. Thus, cases of caudophagy found in the countryside can be underestimated in the refrigerator, since cannibalism can lead to secondary lesions in the carcass.

Morrison and Kritas (2008), in a study of the list of diseases that could be related to caudophagia in slaughterhouses for swines in the state of Minnesota - United States of America, and the presence of inflammation and abscesses in the lungs of swine carcasses was found had a tail bite, considering that there was migration of microorganisms through the bloodstream. Article 134 of RIISPOA (BRAZIL, 2017) states that carcasses with pulmonary lesions can be used conditionally or destined for grease, depending on the degree of the lesion. Breuer et al. (2005) reported in a study carried out on a swine farm on the south coast of the United Kingdom, that tail-biting swines are animals of similar size or larger than those bitten, that is, in this study the smallest animals in the stalls were also the targets of cannibalism. In addition to identifying that the most affected age group was young animals in the nursery phase, and to observe that these cases happened in stalls that did not have the presence of materials that enriched the environment. Likewise, Baptista et al. (2011) observed in a study carried out in the state of Minas Gerais - Brazil, the abnormal behavior of animals in the nursery phase where they were treated according to animal welfare rules, and the tail was not cut and placed in the pens as a means of environmental enrichment.

According to the studies by Harley et al. (2012) and Staaveren et al. (2019) on commercial swine properties on the southern coast of the Republic of Ireland, environmental enrichment measures with chains are less effective in preventing or reducing tail biting, observing superficial injuries, with a reduction in severe cases. Once an outbreak of caudophagy has started, enrichment measures do not reduce the cases, since this intervention has a preventive character, being implemented before the occurrence of injuries (VALROS et al., 2016). Therefore, prevention is the best way to avoid this change in behavior, because the lack of measures to control this disease can generate both financial and quality impacts on meat (HARLEY et al., 2012).

CONCLUSIONS

The incidence of cannibalism in the Northern Mesoregion Mato-Grossense can be considered low in relation to the number of animals slaughtered in a period of four months. The uncomfortable production environments have factors closely related to cannibalism, being difficult to control after the outbreak began. Therefore, the incidence of cannibalism can influence the final carcass yield of swines slaughtered in the finishing phase. But, applying humane slaughter in addition to guaranteeing the animal's well-being at the time of its death, it also reduces the possibility of pre-slaughter stress, thus reducing the incidence of changes in meat quality.

Economic impact assessments are suggested for future studies on the subject. Furthermore, it is necessary to take into account the economic losses caused by the total condemnation and the conditional use of the swine carcasses.

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