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# ANATOMOPATHOLOGICAL ALTERATIONS AND DESTINATIONS OF CATTLE CARCASS IN BRAZIL – 2017 to 2019

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## Abstract

Brazil is a major beef producer and exporter. However, carcasses with anatomopathological alterations can cause economic losses by being the target of some type of condemnation or being conditionally used. The objective of this research work was to analyze the anatomopathological changes and destinations of bovine carcasses in Brazil, from March 30, 2017, to December 31, 2019. Data were collected through the Management Information System of the Federal Inspection Service (SIGSIF), made available online by the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA). It was observed that 67,456,321 bovines were slaughtered, and 2.0% of the carcasses were condemned or conditionally used. The southern region of the country had the highest occurrence of anatomopathological alterations in the carcasses (4.5%), while the Northeast had the lowest (0.1%). The main criterion for judging carcasses in the country was partial condemnation, with 81.7% of judgments established. The main causes of condemnations and conditional use were contamination (31.5%), cysticercosis (21.2%), contusion (11.3%), adenitis (7.4%) and abscess (6.5%). It was noted that a standardization of records in the SIGSIF would be important for a clearer collection of information and for the recording itself by slaughterhouses. The importance of veterinary inspection to guarantee the commercialization of safe meats to consumers was evidenced.

Keywords slaughterhouse, contamination, federal inspection, judgment, SIGSIF

## ALTERAÇÕES ANATOMOPATOLÓGICAS E DESTINOS DAS CARCAÇAS BOVINAS NO BRASIL - 2017 a 2019

## Resumo

O Brasil é um grande produtor e exportador de carne bovina. Entretanto, carcaças com alterações anatomopatológicas podem causar prejuízos econômicos por receberem algum tipo de condenação ou aproveitamento condicional. O objetivo do trabalho foi analisar as alterações anatomopatológicas e os destinos dados as carcaças bovinas no Brasil, no período de 30 de março de 2017 a 31 de dezembro de 2019. Os dados foram coletados por meio do Sistema de Informações Gerenciais do Serviço de Inspeção Federal (SIGSIF), disponível online por meio do MAPA. Observou-se que foram abatidos 67.456.321 bovinos e 2,0% das carcaças foram condenadas ou aproveitadas condicionalmente. A região Sul do país obteve maior ocorrência de alterações anatomopatológicas nas carcaças (4,5%), enquanto o Nordeste obteve a menor (0,1%). O principal critério de julgamento de carcaças no país foi a condenação parcial, com 81,7% dos julgamentos estabelecidos. As principais causas de condenações e aproveitamento condicional foram contaminação (31,5%), cisticercose (21,2%), contusão (11,3%), adenite (7,4%) e abcesso (6,5%). Notou-se que a padronização dos registros no SIGSIF seria importante para coleta mais clara das informações e para o próprio registro por parte dos abatedouros. Evidenciou-se a importância da inspeção veterinária para garantir a comercialização de carnes seguras aos consumidores.

Palavras-chave abatedouro, contaminação, inspeção federal, julgamento, SIGSIF

## INTRODUCTION

Brazil is a major beef producer and exporter. The country recorded a herd of 213.68 million bovines, and a slaughter of 43.3 million in 2019. Of the total meat produced, 76.3% was destined for the domestic market, while 23.6% was destined for export (ABIEC, 2020). As a result, there is now a large number of slaughterhouses throughout the country, where industrial and sanitary inspection must occur in a systematic and efficient manner.

In 1950, with the approval of Law No. 1.283, the mandatory inspection of animal products was established (BRASIL, 1950). Thus, in 1952, Decree No. 30.691 was created, approving the Regulation of Industrial and Sanitary Inspection of Animal-Based Products [*Regulamento da Inspeção Industrial e Sanitária dos Produtos de Origem Animal*] (RIISPOA), which ruled on the actions that became mandatory in 1950 (BRASIL, 1952). After several changes to meet market requirements, the RIISPOA was updated in 2017, with Decree No. 9.013 (BRASIL, 2017).

The beef market represents 8.5% of the annual Brazilian Gross Domestic Product (GDP), reaching a turnover of 618.5 billion reais (ABIEC, 2020). On the opposite direction of these numbers are the damages caused by carcasses with anatomopathological alterations, as they must be condemned. The changes may arise from inappropriate handling of animals, the slaughter process, or from diseases in the rearing process (SOUZA et al., 2018; ALMEIDA et al., 2017).

During the processes of ante-mortem inspection of animals and post-mortem inspection of carcasses inside fridges, the diagnosis of lesions with a wide spectrum of etiological agents is frequent. A wide range of injuries and etiologies leads to different levels of sanitary consequences, requiring professionals to know how to dispose of carcasses, based on the lesion pattern found (DICK et al., 2019; SILVA et al., 2016).

Routine inspection of slaughtered animals is performed from a macroscopic examination of all organs and parts of the carcass. This allows diagnosing pathologies that can develop during the handling of the property of origin, during transport or during the entire slaughter process. Through inspection, it is possible to detect sensory characteristics and lesions related to changes that result in partial or total carcass condemnation (ROMA et al., 2020; BRASIL, 2017).

Therefore, it is up to the veterinarian not only to recognize lesion patterns, but also to have a deep knowledge of the legislation, so that sanitary measures are properly applied. Thus, the intervention of well-trained veterinarians is important to protect human health, preventing the population from consuming animal products of dubious quality, or the spread of zoonotic diseases.

Knowledge of the main diseases that affect animals at the source of production is oftentimes acquired in slaughterhouses, with greater reliability even, due to the large number of animals. Thus, this information can be a starting point for preventive actions. Therefore, the objective of this research work was to analyze the anatomopathological changes and destinations of bovine carcasses determined by the federal inspection in Brazil, from 2017 to 2019.

## MATERIAL AND METHODS

Data were collected with a focus on anatomopathological alterations and destinations, after judgment, of bovine carcasses from slaughterhouses-fridges with Federal Inspection Service [*Serviço de Inspeção Federal*] (SIF) in states in the five Brazilian macro-regions, from March 30, 2017 (after the new RIISPOA regulation), to 31 December 2019.

Data were obtained from SIF records found in the database of the Management Information System of the Federal Inspection Service [*Sistema de Informações Gerenciais do Serviço de Inspeção Federal*] (SIGSIF), made available online by the Ministry of Agriculture, Livestock and Supply [*Ministério da Agricultura, Pecuária e Abastecimento*] (MAPA). The following information was obtained: numbers of slaughtered animals, anatomopathological changes, and the criteria for condemnation or conditional use of the carcasses, established by federal inspection. Such data were organized considering Brazil's states and macro-regions.

There were no records for the states of Rio de Janeiro, Distrito Federal, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas and Amapá. According to the SIGSIF, these states had only Processing Units for Meat and Meat Products, and/or Warehouses for Animal-Based Products (BRASIL, 2020).

The data were organized in Microsoft Excel spreadsheets for calculations of the absolute and relative frequencies of the anatomopathological changes, and of the judgment criteria established for the carcasses. Thus, a descriptive epidemiological

study of a secondary nature was conducted. The research was approved by the Research and Extension Center [*Núcleo de Pesquisa e Extensão*] (NUPEX) of the University Center of Viçosa [*Centro Universitário de Viçosa*] (UNIVIÇOSA), under protocol No. 334.2020.02.01.15.03.

## RESULTS AND DISCUSSION

The Midwest region was responsible for the largest number of slaughtered animals (30,393,326), followed by the North (16,246,126), Southeast (13,585,285), South (5,127,228), and Northeast (2,104,353) (Table 1). Regarding the number of animals with anatomopathological alterations, the Southeast and Midwest regions presented similar values – 493,879 and 493,635, respectively, both corresponding to 35.7% of the total number of carcasses subjected to some type of condemnation or conditional use in Brazil. The values for the South, North and Northeast regions, in their turn, were 16.7, 11.6 and 0.2%, respectively.

Table 1. Number of slaughtered animals and cattle carcasses subjected to some type of condemnation or conditional use by federal inspection, in states and regions of Brazil, from 2017 to 2019 (MAPA, 2020).

| Location | Slaughtered Animals | Condemned used carcasses | Lesion %* | Location %** | Total %*** |
|---|---|---|---|---|---|
| Southeast | 13,585,285 | 493,879 | 35.7 | 3.6 | 0.7 |
| Espírito Santo | 380,221 | 15,339 | 1.1 | 4.0 | 0.0 |
| Minas Gerais | 5,959,130 | 133,680 | 9.7 | 2.2 | 0.2 |
| São Paulo | 7,245,934 | 344,860 | 25.0 | 4.8 | 0.5 |
| South | 5,127,228 | 230,745 | 16.7 | 4.5 | 0.3 |
| Paraná | 2,565,992 | 69,765 | 5.0 | 2.7 | 0.1 |
| Rio Grande do Sul | 2,251,293 | 139,338 | 10.1 | 6.2 | 0.2 |
| Santa Catarina | 309,943 | 21,642 | 1.6 | 7.0 | 0.0 |
| Midwest | 30,393,326 | 493,635 | 35.7 | 1.6 | 0.7 |
| Goiás | 7,970,219 | 102,068 | 7.4 | 1.3 | 0.2 |
| Mato Grosso | 13,052,033 | 298,724 | 21.6 | 2.3 | 0.4 |
| Mato Grosso do Sul | 9,371,074 | 92,843 | 6.7 | 1.0 | 0.1 |
| North | 16,246,126 | 160,749 | 11.6 | 1.0 | 0.2 |
| Acre | 762,692 | 24,381 | 1.8 | 3.2 | 0.0 |
| Amazonas | 134,751 | 1,221 | 0.1 | 0.9 | 0.0 |
| Pará | 6,047,199 | 40,287 | 2.9 | 0.7 | 0.1 |
| Rondônia | 6,629,020 | 44,133 | 3.2 | 0.7 | 0.1 |
| Roraima | 30,549 | 31 | 0.0 | 0.1 | 0.0 |
| Tocantins | 2,641,915 | 50,696 | 3.7 | 1.9 | 0.1 |
| Northeast | 2,104,356 | 2,812 | 0.2 | 0.1 | 0.0 |
| Bahia | 955,648 | 2,347 | 0.2 | 0.2 | 0.0 |
| Maranhão | 1,009,082 | 409 | 0.0 | 0.0 | 0.0 |
| Sergipe | 139,626 | 56 | 0.0 | 0.0 | 0.0 |
| Total | 67,456,321 | 1,381,820 | 100.0 | 2.0 | 2.0 |

* Lesion %: Ratio between number of condemned animals in each state/region and total number of condemned animals.
** Location %: Ratio between number of slaughtered animals and number of condemned animals in each state/region.
*** Total %: Ratio between number of condemned animals in each region and total number of slaughtered animals.

Through the ratio between slaughtered animals and condemned animals by region, it was possible to observe that the South of the country had the highest rates, with 4.5% of condemned cattle carcasses. This rate was above the national average, since, in total, 2.0% of the slaughtered animals suffered some type of condemnation or conditional use.

The percentage of condemnations in the Southeast (3.6%) was also above the average for the country, while the Midwest (1.6%), North (1.0%) and Northeast (0.1%) were below average. The North region is worth highlight, as it has been standing out nationwide, with a growth of more than 10% in its cattle herd in the last 10 years (ABIEC, 2020). The region had the second highest rate of slaughtered animals and a low percentage of condemnation and carcass use.

After post-mortem inspection, meat parts can have different destinations. A slaughtered animal whose half carcasses and organs do not show any changes has total release as destination, that is, it is free for commercialization and consumption (BRASIL, 2017). However, when its carcass presents some anatomopathological change, or its viscera present major lesions, it is sent to the Department of Final Inspection [*Departamento de Inspeção Final*] (DIF) and, thus, may have three different destinations: partial condemnation, total condemnation, and conditional use.

In four of the five Brazilian regions, the main destination after carcass judgment was Partial Condemnation. This rate reached 85.3% of carcasses in the Midwest region, 81.0% in the South , 79.8% in the North, and 79.3% in the Southeast. The exception was the Northeast of the country, which partially condemned only 31.0% of the slaughtered animals (Table 2). According to the legislation, half carcasses and organs that present alterations such as circumscribed benign conditions, traumatic lesions, and limited contamination, are judged as partial rejection, with the injured portion being removed, and the rest of the carcass being released (BRASIL, 1971).

The second most common destination for carcasses was conditional use. These carcasses receive a treatment, at the discretion of the SIF, and are released to be used in the making of preserves, that is, products derived from the industrialization of meat. According to the RIISPOA, there are three different treatment options: cold, salting or heat (BRASIL, 2017).

In the cold treatment, at a temperature not higher than -10°C, the piece is subjected to it for ten days (BRASIL, 2017). This treatment was the destination for 5.9%

Table 2. Destinations established by federal inspection after detection of anatomopathological changes in bovine carcasses, by Brazilian region, from 2017 to 2019 (MAPA, 2020).

| Change | Southeast | | | South | | | Midwest | | | North | | | Northeast | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Total (%)**** |
| Partial Condemnation (Post-mortem) | 391,635 | 79.3 | 2.9 | 186,843 | 81.0 | 3.6 | 421,044 | 85.3 | 1.4 | 128,324 | 79.8 | 0.8 | 873 | 31.0 | 0.0 | 1,128,719 | 81.7 | 1.2E-04 |
| Moist Heat Sterilization (F0 ≥ 3 min.) | 32,981 | 6.7 | 0.2 | 12,140 | 5.3 | 0.2 | 42,389 | 8.6 | 0.1 | 25,410 | 15.8 | 0.2 | 467 | 16.6 | 0.0 | 113,387 | 8.2 | 1.2E-05 |
| Cold Treatment (-10°C/10 days) | 38,111 | 7.7 | 0.3 | 22,926 | 9.9 | 0.4 | 19,003 | 3.8 | 0.1 | 35 | 0.0 | 0.0 | 883 | 31.4 | 0.0 | 80,958 | 5.9 | 8.7E-06 |
| Rendering | 25,777 | 5.2 | 0.2 | 7687 | 3.3 | 0.1 | 9,000 | 1.8 | 0.0 | 6,776 | 4.2 | 0.0 | 532 | 18.9 | 0.0 | 49,772 | 3.6 | 5.3E-06 |
| Total Condemnation (Post-mortem) | 2,061 | 0.4 | 0.0 | 732 | 0.3 | 0.0 | 1296 | 0.3 | 0.0 | 43 | 0.0 | 0.0 | 21 | 0.7 | 0.0 | 4,153 | 0.3 | 4.5E-07 |
| Autoclaving (Incineration) | 1,154 | 0.2 | 0.0 | 4 | 0.0 | 0.0 | 455 | 0.1 | 0.0 | 102 | 0.1 | 0.0 | 1 | 0.0 | 0.0 | 1,716 | 0.1 | 1.8E-07 |
| Charcuterie | 1,483 | 0.3 | 0.0 | 167 | 0.1 | 0.0 | 1 | 0.0 | 0.0 | 10 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1,661 | 0.1 | 1.8E-07 |
| Salting | 552 | 0.1 | 0.0 | 151 | 0.1 | 0.0 | 407 | 0.1 | 0.0 | 20 | 0.0 | 0.0 | 34 | 1.2 | 0.0 | 1,164 | 0.1 | 1.2E-07 |
| Other industrial process | 101 | 0.0 | 0.0 | 42 | 0.0 | 0.0 | 26 | 0.0 | 0.0 | 28 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 197 | 0.0 | 2.1E-08 |
| Sanitary slaughter | 0 | 0.0 | 0.0 | 39 | 0.0 | 0.0 | 2 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 41 | 0.0 | 4.4E-09 |
| Fusion (121°C) | 17 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 12 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 29 | 0.0 | 3.1E-09 |
| Cooking (76.6°C/30 min) | 7 | 0.0 | 0.0 | 14 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 0.0 | 0.0 | 1 | 0.0 | 0.0 | 23 | 0.0 | 2.5E-09 |

* N – Number of carcasses.
* Lesion % – Ratio between number of carcasses judged by criterion and total number of altered carcasses in each region.
*** Location % – Ratio between number of carcasses judged by criterion and number of slaughtered animals in each region.
**** Total % – Ratio between total number of carcasses judged by criterion and total number of slaughtered animals in Brazil.

of the carcasses, taking into account Brazil as a whole. In the Northeast region, it was the main judgment option (31.4%), while in the Southeast and South regions, it was the second, with 7.7 and 9.9%, respectively. In the Midwest region, the criterion appeared only as a third option (3.8%) and, in the North region, with < 0.1% (35 carcasses).

In the salting treatment, the pieces must have a maximum thickness of 3.5 cm, in the form of a blanket, and are put in brine with a minimum of 24 °B (Baumé degrees), where it stays for at least twenty-one days (BRASIL, 2017). Only 0.1% of carcasses in the country were treated this way.

In heat treatment, there are three different methods: cooking at a temperature of 76.6 °C for at least 30 minutes; fusion by heat at a minimum temperature of 121 °C; and sterilization by moist heat with F0 greater than three minutes, followed by immediate cooling (BRASIL, 2017). The main method used among the three heat methods was moist heat sterilization, being the second most used option in the

country (8.2%), considering all destinations. When the regions are analyzed separately, the Midwest (8.6%) and North (15.8%) also established it as second option, while for the South and Southeast, it was the third option, with 5.3% and 6.7%, respectively, and fourth for the Northeast (16.6%). The fusion and cooking treatments were not much used – only in 29 and 23 carcasses, respectively.

Other judgments were conditional destination of the carcasses to charcuterie and other types of industrial process, with 1,661 and 197 carcasses used, respectively.

Half carcasses marked and sent to the DIF during inspection lines, when contaminated with gastrointestinal content to a large extent or present diseases that can put the consumer's health at risk, must be discarded, receiving the judgment of total condemnation (BRASIL, 2017). It was observed that the form of recording is not standardized by slaughterhouses with SIF, and there are markings for total condemnation, rendering and autoclaving/incineration. Sanitary slaughter is also a form of total condemnation, but, in this case, the animal is not taken to the DIF. Summing the numbers of carcasses destined for total condemnation, rendering, autoclaving/incineration and sanitary slaughter, it is possible to observe the real percentage of totally condemned animals by region, as follows: Southeast (5.8%); South (3.6%); Midwest (2.2%); North (4.3%); Northeast (19.6%).

The main changes in carcasses in the Southeast region of Brazil were cysticercosis (26.3%), contamination (24.4%), contusion (11.8%) and adenitis (8.1%) (Table 3). In a study with animals slaughtered in São Paulo, Ferreira et al. (2014) found a prevalence of 4.80% for cysticercosis, unlike this study, which, when taking into account the total number of cysticercosis cases (130,003) and the total number of animals slaughtered in the Southeast region (13,585,285), found a prevalence of 1.0%. On the other hand, Ortunho et al. (2018), in a research conducted in the same state, concluded that 69.13% of the carcasses were condemned due to the presence of cysticercosis. Camba and Alves (2020), in a study conducted in a slaughterhouse with SIF in Minas Gerais, pointed out that, for totally condemned carcasses, tuberculosis (68.8%) and cachexia (19.7%) were the main causes.

Regarding the southern region of the country, the main causes of carcass alterations were cysticercosis (33.2%), contamination (18.9%), actinobacillosis (12.5%), contusion (6.5%) and traumatic lesion (6.0%). Silva et. al (2016) carried out a study on the main causes of cattle carcass condemnation in Paraná and found the following as

Table 3. Anatomopathological alterations in bovine carcasses by Brazilian region, from 2017 to 2019 (MAPA, 2020).

| Change | Southeast | | | South | | | Midwest | | | North | | | Northeast | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Location (%)*** | N* | Lesions (%)** | Total (%)**** |
| Contamination | 120,449 | 24.4 | 0.9 | 43,658 | 18.9 | 0.9 | 217,832 | 44.1 | 0.7 | 52,649 | 32.8 | 0.3 | 169 | 6.0 | 0.0 | 434,757 | 31.5 | 0.6 |
| Cysticercosis | 130,003 | 26.3 | 1.0 | 76,606 | 33.2 | 1.5 | 83,523 | 16.9 | 0.3 | 735 | 0.5 | 0.0 | 1,498 | 53.3 | 0.1 | 292,365 | 21.2 | 0.4 |
| Contusion | 58,219 | 11.8 | 0.4 | 15,096 | 6.5 | 0.3 | 52,184 | 10.6 | 0.2 | 30,510 | 19.0 | 0.2 | 209 | 7.4 | 0.0 | 156,218 | 11.3 | 0.2 |
| Adenitis | 40,000 | 8.1 | 0.3 | 11,338 | 4.9 | 0.2 | 33,968 | 6.9 | 0.1 | 17,335 | 10.8 | 0.1 | 62 | 2.2 | 0.0 | 102,703 | 7.4 | 0.2 |
| Abscess | 51,622 | 10.5 | 0.4 | 8384 | 3.6 | 0.2 | 23,197 | 4.7 | 0.1 | 7,100 | 4.4 | 0.0 | 181 | 6.4 | 0.0 | 90,484 | 6.5 | 0.1 |
| Lymphadenitis | 14,984 | 3.0 | 0.1 | 426 | 0.2 | 0.0 | 20,006 | 4.1 | 0.1 | 17,194 | 10.7 | 0.1 | 12 | 0.4 | 0.0 | 52,622 | 3.8 | 0.1 |
| Actinobacillosis | 4 | 0.0 | 0.0 | 28,840 | 12.5 | 0.6 | 69 | 0.0 | 0.0 | 6 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 28,919 | 2.1 | 0.0 |
| Traumatic lesion (Post-mortem detection) | 3,294 | 0.7 | 0.0 | 13,867 | 6.0 | 0.3 | 5,179 | 1.0 | 0.0 | 3377 | 2.1 | 0.0 | 10 | 0.4 | 0.0 | 25,727 | 1.9 | 0.0 |
| Tuberculosis | 13,026 | 2.6 | 0.1 | 8,214 | 3.6 | 0.2 | 1,052 | 0.2 | 0.0 | 2,041 | 1.3 | 0.0 | 136 | 4.8 | 0.0 | 24,469 | 1.8 | 0.0 |
| Bursitis | 66 | 0.0 | 0.0 | 2 | 0.0 | 0.0 | 472 | 0.1 | 0.0 | 15,111 | 9.4 | 0.1 | 24 | 0.9 | 0.0 | 15,675 | 1.1 | 0.0 |
| Adhesions | 10,072 | 2.0 | 0.1 | 2,323 | 1.0 | 0.0 | 2,147 | 0.4 | 0.0 | 471 | 0.3 | 0.0 | 7 | 0.2 | 0.0 | 15,020 | 1.1 | 0.0 |
| Repulsive appearance | 3,232 | 0.7 | 0.0 | 55 | 0.0 | 0.0 | 3,900 | 0.8 | 0.0 | 5,022 | 3.1 | 0.0 | 30 | 1.1 | 0.0 | 12,239 | 0.9 | 0.0 |
| Pneumonia | 6,377 | 1.3 | 0.0 | 819 | 0.4 | 0.0 | 4,117 | 0.8 | 0.0 | 361 | 0.2 | 0.0 | 27 | 1.0 | 0.0 | 11,701 | 0.8 | 0.0 |
| Nonspecific Lymphatic Alteration | 6,165 | 1.2 | 0.0 | 236 | 0.1 | 0.0 | 4,398 | 0.9 | 0.0 | 849 | 0.5 | 0.0 | 2 | 0.1 | 0.0 | 11,650 | 0.8 | 0.0 |
| Pododermatitis | 743 | 0.2 | 0.0 | 6 | 0.0 | 0.0 | 9,744 | 2.0 | 0.0 | 185 | 0.1 | 0.0 | 0 | 0.0 | 0.0 | 10,678 | 0.8 | 0.0 |
| Mastitis | 3,787 | 0.8 | 0.0 | 1,049 | 0.5 | 0.0 | 2,813 | 0.6 | 0.0 | 681 | 0.4 | 0.0 | 2 | 0.1 | 0.0 | 8,332 | 0.6 | 0.0 |
| Neoplasm | 1,701 | 0.3 | 0.0 | 865 | 0.4 | 0.0 | 3,493 | 0.7 | 0.0 | 648 | 0.4 | 0.0 | 15 | 0.5 | 0.0 | 6,722 | 0.5 | 0.0 |
| Bronchitis | 5,444 | 1.1 | 0.0 | 0 | 0.0 | 0.0 | 924 | 0.2 | 0.0 | 125 | 0.1 | 0.0 | 2 | 0.1 | 0.0 | 6,495 | 0.5 | 0.0 |
| Suppurative Lesion | 30 | 0.0 | 0.0 | 6,011 | 2.6 | 0.1 | 201 | 0.0 | 0.0 | 29 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 6,271 | 0.5 | 0.0 |
| Brucellosis | 98 | 0.0 | 0.0 | 5,064 | 2.2 | 0.1 | 67 | 0.0 | 0.0 | 596 | 0.4 | 0.0 | 30 | 1.1 | 0.0 | 5,855 | 0.4 | 0.0 |
| Other alterations | 24,563 | 5.0 | 1.4 | 7,886 | 3.4 | 0.2 | 24,349 | 4.9 | 0.1 | 5,724 | 3.6 | 0.0 | 396 | 14.1 | 0.0 | 62,918 | 4.6 | 0.1 |

* N - Number of carcasses.
** Lesion % – Ratio between the absolute frequency of a given anatomopathological alteration and the number of altered carcasses in the same region.
*** Location % – Ratio between the absolute frequency of a given anatomopathological alteration and the number of slaughtered animals in the same region.
**** Total % – Ratio between the absolute frequency of a given anatomopathological alteration in the country and the total number of animals slaughtered in the studied period.

the most prevalent ones: thinness (24.74%), contusion (14.53%) and contamination (14.43). Taking all lesions into account, regardless of the final destination, as done in the present study, thinness was responsible for 0.2% of carcass alterations (453/230,745). This number rises when considering only the carcasses condemned in the region, reaching 0.82% (70/8,462); however, it still differs from the results found by previous authors. On the other hand, Dick et al. (2019) observed cysticercosis (42.52%), tuberculosis (17.43%), advanced pregnancy (11.73%) and contusions (5.1%) as the main changes in carcasses in Rio Grande do Sul's slaughterhouses.

During the study period, the main changes in carcasses in the Midwest region

were contamination (44.1%), cysticercosis (16.9%), contusion (10.6%), adenitis (6.9%) and abscess (4.7%). Taking into account the total number of slaughtered animals, contamination was responsible for 0.7% of the total number of animals. Pedroso et al. (2019) obtained similar results in their studies, with a prevalence of 0.717% in 2015, 1.051% in 2016, and 2.016% in 2017, for contamination in a slaughterhouse in Mato Grosso. The authors also observed abscesses in 0.089% of the animals slaughtered in 2015, 0.081% in 2016, and 0.068% in 2017, corroborating with the finding of the present study (0.1%). As for presence of cysticercosis, in this study, the alteration was found in 0.3% of the slaughtered animals, a value similar to that of Strutz et al. (2015), who observed a prevalence of 0.2% in Mato Grosso.

The North region, in its turn, had contamination (32.8%), contusion (19.0%), adenitis (10.8%), lymphadenitis (10.7%) and bursitis (9.4%) as the main causes of carcass alterations. Among all bovine carcasses with alterations in slaughterhouses in the state of Pará, Damasceno Neto et al. (2021) observed that contusion was the leading cause of changes (35.1%), followed by contamination (29.5%).

Finally, the Northeast of the country had cysticercosis (53.3%), contusion (7.4%), abscess (6.4%), contamination (6.0%) and tuberculosis (4.8%) as the main cause of alterations. Analyzing the causes of condemnations in a slaughterhouse in Garanhuns (PE), Almeida et al. (2017) observed that the main ones were found in viscera. In carcasses, the authors found higher prevalence of fractures (0.24%), contusions (0.12%) and tuberculosis (0.12%). Rossi et al. (2014) reported a cysticercosis prevalence of 0.28 to 1.74% in cattle slaughtered in municipalities in the Northeast region. Despite the importance of the disease, the authors report that its low prevalence compared to that of other areas is due to the region having one of the smallest herds in Brazil and to the scarcity of studies carried out in said region.

Taking into account the total number of condemnations and conditional use in Brazil, the main anatomopathological alterations of the carcasses were contamination (31.5%), cysticercosis (21.2%), contusion (11.3%), adenitis (7.4%) and abscess (6.5%). Likewise, such changes were observed in the Midwest and Southeast of the country, with the latter having only a different order of prevalence (cysticercosis, contamination, contusion, abscess and adenitis). In the South, among the five main lesions, three were equivalent (cysticercosis, contamination and contusion), ranging from actinobacillosis and traumatic injury.

The North of the country had contamination, contusion and adenitis among the five most important causes; on the other hand, it was the only region that did not have cysticercosis among the main causes. The high prevalence of the taeniasis-cysticercosis complex is linked to high human population density, and, therefore, the low human population density in the region and a sparsity of studies on the epidemiology and notifications of the disease in the region may be the causes for the low condemnation and use of cattle carcasses (Alves et al., 2017; Rossi et al., 2014). Finally, the Northeast, which differed only in adenitis, with tuberculosis being among the five most influential causes of carcass damage.

Contamination was the main cause of carcass alterations in Brazil (31.5%). Above this average are the Midwest and North regions. Below it are the Southeast and South, with the Northeast having better rates.

According to the RIISPOA, carcasses, parts of carcasses, and organs that present an extensive area of contamination by gastrointestinal contents, urine, milk, bile, pus, or other contamination of any nature, must be condemned when it is not possible to completely remove the contaminated area. For cases in which it is not possible to perfectly delimit the contaminated areas, even after their removal, the carcasses, parts of the carcasses, organs or viscera must be destined for sterilization by heat. When complete removal of the contamination is possible, the carcasses, parts of the carcasses, organs or viscera can be released (BRASIL, 2017).

Only the Northeast showed low contamination rates. Contamination is indeed a problem, since, in most situations, it is necessary to discard the meat parts, resulting in many losses. The main causes of condemnation for contamination are inappropriate handling of carcasses and viscera, especially during skinning and evisceration (ISRAEL et al., 2014). It is necessary to train slaughterhouse staff regularly, mainly because it is a cause of condemnation that can be prevented, thus resulting in better rates of use.

Cysticercosis, the disease responsible for the second greatest cause of condemnation in the country (21.2%), is a problem in the Northeast, South, Southeast and Midwest. Rossi et al. (2014) pointed out the Southeast region as the one with the highest occurrence of the alteration, diverging from the results obtained in this study, and agreeing on the North region being the one with the lowest occurrence. The authors commented on the small number of studies and few research works reporting

the situation of the disease in the North and Northeast regions.

In an effort to reduce the rates of the second main cause of lesions in bovine carcasses in Brazil, strategies to combat cysticercosis must be carried out. They must be implemented in accordance with the identified regional endemics, the health status of the herd, the profile of the production system, and the guidelines of the state defense agency. Measures must take into account multidisciplinary aspects that interrupt the cycle of the parasite, in addition to training the workforce with improvement of post-mortem diagnostic methods in slaughterhouses by updating inspection agents and veterinarians (BAVIA et al., 2012).

According to the analysis, lesions by contusion had an occurrence of 11.3% in Brazil, with the North, Midwest and Southeast regions having high occurrences. Pereira et al. (2013), in a study conducted in a slaughterhouse with Federal Inspection System in Pará, found that at least 90% of the animals had lesions in that period. The authors concluded that the distance traveled to the slaughterhouses were significant for the appearance of such lesions, which were mostly recent. However, in the state of Paraná, Silva et al. (2016) also noted that contusions were among the leading causes of condemnation. The authors also observed that pre-slaughter management failures, long distances from the property to the slaughterhouse, and road conditions are determinants for lesions. Finally, the authors showed that these lesions end up limiting the slaughterhouse to commercialize internationally.

According to the RIISPOA, animal carcasses with generalized contusion or multiple fractures must be condemned. Those with extensive lesions, without having been totally compromised, should be subjected to heat treatment after the affected areas have been removed and condemned. Finally, carcasses with contusion, fractures or localized sprain can be released after the affected areas have been removed and condemned (BRASIL, 2017).

Fourth cause of anatomopathological alterations in carcasses, adenitis had an occurrence of 7.4%, with the North and Southeast regions having higher rates, and the Midwest, South and Northeast, lower rates.

Abscess was responsible for 6.5% of changes in carcasses, being the fifth most prevalent cause in Brazil. The Southeast region recorded the worst results, with a rate almost twice as high (10.5%). The other regions obtained values lower than the country's margin. In studies conducted in slaughterhouses in the North of the country,

the results found by Monte et al. (2018) and Dian et al. (2020) differ from the low rates of abscess in the same region that were found here. The authors reported a prevalence of 66% and 97%, respectively, of abscess lesions in slaughtered carcasses.

Two causes of anatomopathological alterations of great importance in cattle carcasses are tuberculosis and brucellosis, which, despite not being the main causes of condemnation and conditional use in the present study, are zoonoses and can lead to diseases in those who consume the meat pieces.

Tuberculosis in Brazil was the cause of 1.8% of the carcasses condemned in the studied period. The Northeast and South regions had the highest rates in the country, 4.8% and 3.6%, respectively, followed by the Southeast (2.6%), North (1.3%) and Midwest (0.2 %). As for the number of slaughtered animals, the prevalence in Brazil was 0.03%. Neves et al. (2017), in a study conducted in different slaughterhouses in the country, found that 0.065% of slaughtered carcasses had lesions suggestive of tuberculosis. This rate drops when the confirmatory laboratory test is performed, with 0.0015% being the prevalence of confirmed cases. Despite the low numbers, the authors considered it a worrying factor, since bovine tuberculosis is an occupational zoonosis and represents a serious public health problem.

Brucellosis, an important disease due to its zoonotic character, was responsible for 0.4% of the causes of carcasses being sent to the Department of Final Inspection. Such condemnation had low rates in Brazil, with a prevalence of 0.0086% in slaughtered animals.

The results identified as Other Alterations were due to 133 different causes, the most relevant being: inflammatory lesions, actinomycosis, delayed evisceration, thinness and peritonitis. They were responsible for a total of 62,918 carcasses diverted to the Department of Final Inspection, accounting for 4.6% of the country's total.

The tool for monitoring the actions of the Federal Inspection Services, SIGSIF-MAPA, is an important database for records on production, commercialization, import, export, slaughter, and changes in products from registered establishments. However, it was noted that a standardization of records would be important for a clearer collection of information and for the recording itself by slaughterhouses. It is necessary to improve the SIF's management information system, with a view to obtaining protocol data in order to facilitate the analysis and contribute to the creation of public policies aimed at solving the main problems that affect the meat market in

the country.

## CONCLUSIONS

The occurrence of condemnation and conditional use of cattle carcasses in Brazil stands at 2.0%. Among the regions of the country, the South had the highest occurrence of anatomopathological alterations in the carcasses, while the Northeast had the lowest. The main destination of carcasses after federal inspection was partial condemnation. The main causes of carcass alteration were heterogeneous among the regions of the country, but contamination and contusion are among the most prevalent in all of them. In Brazil, the most prevalent causes of carcass marking were contamination, cysticercosis, contusion, adenitis and abscess. It was possible to evidence the importance of veterinary inspection and supervision as to the condemnation of cattle carcasses in order to guarantee the selling of safe meats to consumers.

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