

ANALYSIS OF THE ECONOMIC LOSS AND THE MAIN CAUSES OF TOTAL CONDEMNATION OF POULTRY CARCASSES UNDER BRAZILIAN FEDERAL INSPECTION BETWEEN 2013 AND 2017

(Análise da perda econômica e das principais causas de condenações totais de carcaças de aves sob Inspeção Federal Brasileira entre 2013 e 2017)

Weyber Ferreira de Souza¹, Melissa Debesa Belizário Granjeiro¹, Diego Pierotti Procópio¹

¹Universidade Federal de Mato Grosso

Corresponding author: weyberfs@gmail.com

ABSTRACT: The present study aimed to identify the main causes of total condemnation of poultry carcasses, under Federal Inspection in the Brazilian states from 2013 to 2017 and to estimate the economic loss on these condemnations. The Brazilian poultry industry is an international highlight, being the largest exporter and the second-largest producer of chicken meat in the world. In the poultry meat production process, the adopted mechanism to ensure food safety is inspection in industry. If the carcasses showed some kind of health problem order, rendering it unfit for human consumption, they may be totally or partially condemned. The main causes identified of total condemnations were Repugnant Aspect, Contamination, Colibacillosis, and Cachexia. The estimated economic loss for the period in Brazil was US\$ 175.56 million. Actions that aim the biosafety at farm, sanitary management protocols and constant training to employees in the industry can contribute to minimizing these productive losses at slaughter.

Keywords: Repugnant appearance, contamination, poultry meat, food safety.

RESUMO: O presente estudo teve como objetivo identificar as principais causas de condenações totais de carcaças de aves, sob Inspeção Federal, nos estados brasileiros no período de 2013 a 2017 e estimar a perda econômica sobre essas condenações. A indústria avícola brasileira é destaque internacional, sendo a maior exportadora e segunda maior produtora mundial de carne de frango. No processo produtivo da carne avícola, o mecanismo adotado para a garantia da segurança dos alimentos é a fiscalização na indústria. Caso as carcaças apresentem algum tipo de problema de ordem sanitária, que as torne impróprias para o consumo humano, estas podem ser condenadas totalmente ou parcialmente. As principais causas de condenações totais identificadas foram Aspecto Repugnante, Contaminação, Colibacilose e Caquexia. A perda econômica estimada, para o período no Brasil foi de US\$ 175,56 milhões. Ações que visem a biossegurança das granjas, protocolos de manejo sanitário e treinamento constante a colaboradores na indústria podem contribuir para minimizar essas perdas produtivas ao abate.

Palavras-chave: Aspecto repugnante, contaminação, carne avícola, segurança dos alimentos.

INTRODUCTION

Brazil ranks as the largest exporter and second-largest producer of chicken meat in the world. In the year of 2017 a total of 4,320 million tons were exported and produced about 13,056 million tons of meat. Most of the Brazilian's poultry meat production is directed to the domestic market, being the equivalent of 66% of total production. It is worth noting that the annual *per capita* consumption of Brazilian poultry meat increased from 37,02 kilos in 2007 to 42,07 kilos in 2017 (ABPA, 2018).

According to reports from the Department of Animal Products Inspection (DIPOA) of the Ministry of Agriculture, Livestock and Supply (MAPA), in the period from 2013 to 2017 a total of 26,69 billion birds were slaughtered in Brazil, highlighting the South region, which represented in the period, about 63% of the national total.

In order to ensure food safety and the quality of the meat marketed, sanitary inspections are carried out in the processing industries. They can be at the federal, state or municipal level, in the inspection steps ante mortem and post mortem with the objective of identifying sanitary risks in the carcass of the animal.

If any problem is identified, partial or total condemnation of the carcass may occur (Portilho, 2016).

The total of condemnations by poultry carcasses represents significant economic losses for the Brazilian poultry sector, since part of the industrialized product is no longer sold to domestic and foreign markets. Mendonça *et al.* (2011) emphasize the importance of investigating factors associated with the occurrence of economic losses from carcass condemnations in meat production chains.

Based on these discussions, the purpose of main goal of this article is to determine the economic loss and the

main causes of total condemnation of poultry carcasses in slaughterhouses under the supervision of the Federal Inspection System (SIF) in the main Brazilian federative units producing poultry meat in the period from 2013 to 2017.

MATERIALS AND METHODS

To determine the economic losses and the analysis of the main causes of total condemnation of poultry carcasses in slaughterhouses under SIF supervision, a survey of the annual reports by the state of the Federal Inspection Service's Management Information System (SIGSIF) in the period from 2013 to 2017 and the following variables were selected: (i) total amount of slaughter per federative unit; (ii) number of total condemnations per federative unit; and, (iii) the main causes of total condemnations per federative unit.

Municipal (SIM) and state (SIE) inspection data were not used in this study, as most of them do not have public platforms to access their inspection reports. The prevalence of total condemnations per case in relation to total condemnations of poultry carcasses was determined based on the adaptation of Salines *et al.* (2017) and presented in Equation 1.

$$Prevalence_{cause} = \frac{\text{Quantitative total convictions for cause}}{\text{Quantitative total convictions}} \times 100 \quad (1)$$

The period analyzed was from January 2013 to December 2017. The federative units evaluated were Santa Catarina, Rio Grande do Sul, Paraná, Minas Gerais, São Paulo, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Bahia, Pernambuco, Tocantins, and Pará. These states were selected considering the availability of

slaughtering and condemnation data by SIF in Brazil.

Thus, the determination of the economic loss will be performed from Equation 2.

$$Economic\ loss_{year} = NCD \times AMYC \times AAPP\text{M} \quad (2)$$

Where: NCD= Number of carcasses condemned by year; AMYC = Average meat yield per carcass; and, AAPP\text{M} = Average annual kilo price of poultry meat.

The average meat yield per carcass is 79% according to the study by Lara et al. (2005) and the average slaughter weight of 2.5 kilos, as recommended by Ebling and Basurco (2016). Thus, the amount of meat for each poultry carcass was 1.975 kilos. The price series of the kilo of chicken meat was taken from the Agrolink portal database (<https://www.agrolink.com.br/cotacoes/historico/>).

The price of kilo series of poultry meat was not available for all Brazilian states. Thus, for some localities, the reference price series were used. The Santa Catarina price series was used as a reference for the state of Rio Grande do Sul, while that of São Paulo served as a reference for Mato Grosso and Mato Grosso do Sul. Finally, the state of Minas Gerais was the reference for the state of Espírito Santo, Goiás, Bahia, Pernambuco, Tocantins and Pará. The criterion of selection of the *proxy* is the territorial proximity with the reference state.

After determining the economic loss for the analyzed period, the monetary values were updated for the year 2017 using the General Price Index (IGP-DI) determined by Getúlio Vargas Foundation (FGV).

The IGP-DI was used to compare the monetary value of a historical series

to a base date value (Pereira and Ramalho, 1998).

Updates of monetary values were performed using Equation 3.

$$Real\ value_{year} = \left(\frac{Nominal\ value_{year}}{IGP - DI_{year}} \right) \times IGP - DI_{base} \quad (3)$$

Where: *Real value*_{year} = value of the economic loss updated for the year 2017; Nominal value_{year} = value of the estimated economic loss for each year in the period from 2013 to 2017; IGP-DI_{year} = General Price Index for each year of the period from 2013 to 2017; and, IGP-DI_{base} = General Price Index for the year 2017.

The dollar value was based on the historical series recorded by The Center for Advanced Studies in Applied Economics (Cepea), a part of the Department of Economics, Administration and Sociology of the "Luiz de Queiroz" School of Agriculture (Esalq) of the University of São Paulo (USP).

RESULTS

In the period of 2013 and 2017, 26.6 billion birds were slaughtered in Brazil in slaughterhouses under SIF supervision.

The states of the southern region, Paraná (with 8.72 billion), Santa Catarina (with 4.36 billion) and Rio Grande do Sul (with 3.73 billion), which jointly accounted for 16.81 billion (63% of the national total) (MAPA, 2018).

The first table shows the information of the total slaughter, the number of total condemnations of poultry carcasses and the economic loss in the federative units producing poultry meat from 2013 to 2017.

Table 1. The total slaughter of poultry and total carcass condemnations, in units, and the economic loss in the Brazilian federal units from 2013 to 2017.

States	total carcasses slaughtered (units)	Total carcasses condemnations (units)		Economic loss (US\$)
	N	N	%	
Santa Catarina	4.362.877.275	15.304.654	0,35	24.160.221,55
Rio Grande do Sul	3.730.541.907	19.155.259	0,51	31.690.544,50
Paraná	8.725.682.729	29.163.277	0,33	54.741.892,72
Minas Gerais	1.963.573.178	2.457.695	0,13	5.242.250,59
São Paulo	2.650.292.466	11.018.642	0,42	22.165.989,26
Espírito Santo	147.115.407	1.563.740	1,06	3.024.391,46
Goiás	1.833.573.543	4.922.346	0,27	10.482.948,06
Mato Grosso	1.155.568.122	1.432.372	0,12	2.402.670,33
Mato Grosso do Sul	820.485.795	5.833.560	0,71	11.405.322,31
Distrito Federal	379.936.256	-	-	-
Bahia	202.107.135	2.237.362	1,11	4.970.297,22
Paraíba	104.463.475	-	-	-
Pernambuco	232.187.313	982.825	0,42	1.998.226,56
Tocantins	107.124.952	881.999	0,82	1.777.455,08
Pará	193.018.155	603.012	0,31	1.498.174,03
Rondônia	56.079.744	-	-	-
Piauí	25.848.338	-	-	-
TOTAL	26.690.475.790	95.556.743	0,36	175.560.383,67

Source: Agrolink (2018), FGV (2018), CEPEA (2019) and MAPA (2018). Note: N - units; % - the prevalence of total condemnations relative to the total slaughter.

The federal units of Federal District (DF), Paraíba (PB), Rondônia (RO) and Piauí (PI), although they have slaughter records, do not have total condemnation reports available on the SIF platform in the analyzed period (Table 1).

The prevalence of total condemnations of poultry carcasses in relation to total slaughter in Brazil was 0.36% for the period from 2013 to 2017. In addition, in this case, the economic loss determined was US\$ 175.56 million (Table 1).

In relation to the Brazilian regions, the distribution percentage of the total condemnations of poultry carcasses in the South region was 66.58% of the national total, followed by the Southeast region, with a participation of 15.73% of the national total and the Center-West with a rate of 12.75% (Table 1). Table 2 presents information on the main causes of total condemnation of poultry carcasses in the southern region for the period from 2013 to 2017.

Table 2 shows the occurrence of total condemnation in the southern states of Rio Grande do Sul (RS), Santa Catarina (SC) and Paraná (PR), which have had the highest records of the country. The main causes of condemnation in the analyzed region were: repugnant aspect, contamination, colibacillosis, Cachexia, and ascitic syndrome.

It is worth highlighting the total condemnation of bird carcasses by repugnant aspect as being the most prevalent in all the states analyzed in the period from 2013 to 2017. The condemnation for cachexia was more prevalent in the State of RS with a participation of 15.25%, compared to PR and SC (Table 2).

Table 3 presents information on the main causes of the total condemnation of poultry carcasses, both in quantity and percentage share, in slaughterhouses located in the Southeast region from 2013 to 2017.

Table 2. Quantity and percentage of the main causes of total condemnation of poultry carcasses in the southern states of Brazil from 2013 to 2017 period.

Main causes	Rio Grande do Sul (RS)		Paraná (PR)		Santa Catarina (SC)	
	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)
Repugnant aspect	4.989.701	26,05	9.805.242	33,62	3.877.512	25,34
Contamination	2.222.315	11,60	4.284.295	14,69	2.536.242	16,57
Colibacillosis	1.719.842	8,98	2.236.294	7,67	1.968.108	12,86
Cachexia	2.921.113	15,25	1.933.064	6,63	805.505	5,26
Excessive scalding	1.381.778	7,21	2.848.422	9,77	954.628	6,24
Ascitic Syndrome	1.721.829	8,99	3.489.485	11,97	1.203.446	7,86
Bloody meat	902.590	4,71	1.254.545	4,30	130.322	0,85
Cellulitis	476.236	2,49	1.044.958	3,58	484.879	3,17
Contusion / Traumatic injury	251.830	1,31	338.680	1,16	366.554	2,40
Dermatitis	134.388	0,70	387.496	1,33	423.393	2,77
Other causes	2.433.637	12,70	1.540.796	5,28	2.554.065	21,95
TOTAL	19.155.259	100,0	29.163.277	100,0	15.304.654	100,0

Source: MAPA (2018). Note:% - The convictions percentage for each cause was determined per state in relation to the total number of convictions.

Table 3. Quantity and percentage share of the main causes of total condemnation of poultry carcasses in the states of the Southeast region of Brazil from 2013 to 2017 period.

Main causes	São Paulo (SP)		Minas Gerais (MG)		Espírito Santo (ES)	
	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)
Repugnant aspect	2.677.479	24,30	1.099.077	44,72	86.925	5,56
Cachexia	1.392.959	12,64	330.274	13,44	140.962	9,01
Hemorrhagic viscera	-	-	-	-	1.110.930	71,04
Colibacillosis	962.707	8,74	744	0,03	18.039	1,15
Contamination	516.172	4,68	335.298	13,64	8	0,00
Aerosaculitis	689.337	6,26	63.403	2,58	323	0,02
Ascitic Syndrome	972.080	8,82	170.215	6,93	81.026	5,18
Excessive scalding	432.319	3,92	122.704	4,99	74.432	4,76
Neoplasm	478.302	4,34	22.860	0,93	179	0,01
Contusion / Traumatic injury	457.776	4,15	27.304	1,11	64	0,00
Other causes	2.439.511	22,14	285.816	11,63	50.852	3,25
TOTAL	11.018.642	100,0	2.457.695	100,0	1.563.740	100,0

Source: MAPA (2018). Note:% - The percentage of convictions for each cause was determined by state in relation to the total convictions.

Table 3 demonstrates that the repugnant aspect was the main cause in MG (44.72%) and SP (24.30%). In the ES state, the main cause was the hemorrhagic viscera for the analyzed period.

Table 4 provides information on the main causes of total condemnation of poultry carcasses, in relation to the quantity and percentage share, for the states of the Midwest region from 2013 to 2017.

Table 4. Quantity and percentage of the main causes of total condemnation of poultry carcasses in the states of the Midwest region of Brazil from 2013 to 2017 period.

Main causes	Mato Grosso (MT)		Mato Grosso do Sul (MS)		Goiás (GO)	
	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)
Contamination	351.920	24,57	1.547.294	26,52	1.627.271	33,06
Repugnant aspect	159.563	11,14	1.441.392	24,71	693.269	14,08
Colibacillosis	97.252	6,79	969.959	16,63	102.463	2,08
Ascitic Syndrome	118.171	8,25	408.665	7,01	337.569	6,86
Cachexia	68.621	4,79	223.394	3,83	449.839	9,14
Excessive scalding	103.833	7,25	282.872	4,85	311.428	6,33
Delayed evisceration	39.465	2,76	108.196	1,85	135.170	2,75
Aerosaculitis	120.522	8,41	95.723	1,64	65.910	1,34
Abnormal coloring	-	-	277.470	4,76	-	-
Bloody meat	8.350	0,58	48.086	0,82	195.406	3,97
Other causes	364.675	30,25	430.509	7,38	1.004.021	21,74
TOTAL	1.432.372	100,0	5.833.560	100,0	4.922.346	100,0

Source: MAPA (2018). Note: % - The percentage of convictions for each case was determined per state in relation to the total number of convictions.

In table 4 it is observed the main cause was contamination, with the prevalence of 33.06%, 26.52% and 24.57% in the federative units of MT, MS and GO, respectively. The repugnant aspect and the Colibacillosis were the 2nd and 3rd major causes registered in the analyzed region, respectively.

Table 5 presents information on the main causes of total condemnation of poultry carcasses for the states of Bahia (BA) and Pernambuco (PE) from 2013 to 2017.

In the Northeast Region, represented by the states of BA and PE, in the analyzed period, the main cause of total condemnation of poultry carcasses was aerosaculitis in BA (35.20%) and repugnant aspects in PE (44.93%). Besides that, colibacillosis, contamination, and cachexia all presented relevant percentages in these federative units in the period from 2013 to 2017 (Table 5).

Table 6 presents information on the main causes of total condemnations

in the states of Tocantins (TO) and Pará (PA) for the period from 2013 to 2017.

Table 6 shows that repugnant aspect, cachexia, blood meats colibacillosis and dead collected birds are the main causes of total condemnation of carcasses in TO and PA states, representing the Northern region for the period from 2013 to 2017.

Table 5. Quantity and percentage of the main causes of total condemnation of poultry carcasses in the states of the Northeast region of Brazil, from 2013 to 2017 period.

Main causes	Bahia (BA)		Pernambuco (PE)	
	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)
Aerosaculitis	787.525	35,20	23.070	2,35
Repugnant aspect	353.625	15,81	441.593	44,93
Colibacillosis	456.778	20,42	49.743	5,06
Contamination	184.780	8,26	102.250	10,40
Cachexia	42.549	1,90	123.620	12,58
Excessive scalding	107.550	4,81	31.647	3,22
Contusion / Traumatic injury	43.294	1,94	82.209	8,36
Ascitic Syndrome	74.339	3,32	47.661	4,85
Bloody meat	58.754	2,63	40.048	4,07
Delayed evisceration	40.721	1,82	32.367	3,29
Cellulitis	35.778	1,60	1.200	0,12
Other causes	51.669	2,31	7.417	0,75
TOTAL	2.237.362	100,0	982.825	100,0

Source: MAPA (2018). Note: % - The percentage of convictions for each case was determined per state in relation to the total number of convictions.

Table 6. Quantity and percentage of the main causes of total condemnation of poultry carcasses in the North region of Brazil from 2013 to 2017.

Main causes	Tocantins (TO)		Pará (PA)	
	Total condemnations (units)	Total (%)	Total condemnations (units)	Total (%)
Repugnant aspect	105.725	11,99	148.403	24,61
Cachexia	103.985	11,79	141.467	23,46
Collected dead	158.801	18,00	33.149	5,50
Bloody meat	69.117	7,89	68.858	11,42
Colibacillosis	109.019	12,36	18.647	3,09
Excessive scalding	66.039	7,49	29.028	4,81
Dermatitis	62.979	7,14	3.118	0,52
Contamination	39.161	4,44	12.712	2,11
Aerosaculitis	21.636	2,45	17.807	2,95
Contusion / Traumatic injury	14.921	1,69	19.785	3,28
Other causes	130.616	14,81	110.038	18,25
TOTAL	881.999	100,0	603.012	100,0

Source: MAPA (2018). Note: % The percentage of convictions for each case was determined per state in relation to the total number of convictions.

DISCUSSION

During this studying period, Brazil recorded a total carcass condemnation rate of 0.36% in establishments under Federal Inspection. In a research made by Salines *et al.* (2017), carcass condemnations rates were identified at different times and countries where: Canada (2.87%), Germany (1.57%), United States (1.01%), France (1.8%), Iran (0.33%) and the United Kingdom (1.23%). These studies did not address estimated economic loss.

This topic presents the associated factors for the occurrence of the main causes of total condemnation of poultry carcasses in slaughterhouses under SIF in Brazilian federal units.

In order to guarantee food safety and quality, the Regulation of Industrial and Sanitary Inspection of Products of Animal Origin (RIISPOA) was reissued in 2017, coming into force in 2018 therefore the period of this study used as a reference the decree 30.691 of

1952 and other modifications, compared to the new RIISPOA, where appropriate.

Factors associated with total condemnation by repugnant aspect

The repugnant aspect was one of the main causes of total condemnation of carcasses recorded in the states of the South, Southeast and North regions (Tables 2, 3 and 6) and was the second cause of higher condemnation in the states of the Midwest and Northeast regions (Tables 4 and 5, respectively).

RIISPOA, in article 172, defined that "Repugnant meats are therefore considered and condemned for carcasses that appear to have a bad appearance, abnormal coloring, or exude medicinal and excremental, sexual or unusual odors." In article 236, it states that birds, including the hunting ones, should be condemned to putrefactive alterations, exuding ammoniacal sulfuric odor, revealing gassy crackling on palpation or modifying the color of the musculature (Brazil, 1998). The new RIISPOA addresses this theme in article 143, but without major changes compared to the previous legislation (Brazil, 2017).

In Goscinski's study (2016), conducted in the State of Paraná, he also identified the Repugnant aspect as the main cause of total condemnation, with a prevalence of 32.32%. Ferreira et al. (2012) when evaluating RS state's data, observed in the period from 2009 to 2011, the repugnant aspect represented about 19.4% of total condemnations, being the third cause of greatest occurrence.

Unlike this research, Oliveira, et al. (2016) evaluating the main causes of total and partial condemnation in poultry slaughtering in Brazil on the period from 2006 to 2011, recorded a frequency of condemnations for Repugnant Appearance of 2.2%.

In addition, it is noted that the occurrence of repugnant appearance is associated with chronic and acute stress in the pre-slaughter stage, which can be considered an important factor that affects directly the quality and the appearance of the carcass (Langer, 2007). Studies had related bird stress to excessive handling with strains, especially for capture, high birds density, thermal stress during transport and waiting time for slaughter (Rui, et al., 2011; Brito, et al., 2010)

Factors associated with total condemnation by contamination

The total condemnations for contamination presented a varied occurrence among the analyzed regions. The largest records were in the Midwest (Table 4) and in the South (Table 2), which was the second largest cause of total condemnation of poultry carcasses. Oliveira et. al (2016) also identified contamination as an important cause of condemnation (total and partial) of poultry carcasses in Brazil, registering a frequency of 30.0% in the period from 2006 to 2011.

During the process of slaughtering poultry in slaughterhouses, the microbiological quality of the carcass is a fundamental factor for determining food safety that directly reflects on human health and contributes to the shelf life of processed foods (Freitas, 2015).

The total condemnations of poultry carcasses by contamination are mainly associated with the pre-slaughtering fast improves, as it compromises the emptying of the digestive system. In addition, the faults in the processing steps, during the opening of the celiomatic cavity, may occur fecal extravasation and content of the pap in the carcass (Rui et al., 2011; Freitas, 2015).

As a strategy for reducing contamination, raising awareness about the importance of producing uniform lots, respecting pre-slaughter fasting, in case of automated evisceration, correctly calibrated equipment and providing training to employees from harvesting to processing in the industry can contribute to reducing the occurrence of contamination (Ebling and Basurco, 2016).

Among the pathogens associated with poultry farming, the *Salmonella* genus and its importance in food safety stand out. During the processing stages, contaminations of the environment, manipulators and cross-contamination among other contaminated birds may occur (Tessari, 2008).

Lanier *et al.* (2018) identified that *Salmonella spp.* is one of the leading causes of bacterial foodborne infections in the United States. Although rarely fatal, they cause severe gastrointestinal disorders. In the study, the liver of the bird is identified as an important vehicle for the transmission of the infection. Pathogens are believed to spread through the gastrointestinal tract.

According to RIISPOA, carcasses or part of them contaminated with feces during the slaughter process should be condemned. The carcasses, part of the carcass or organs contaminated due to contact with the floor or in any other way, will also be condemned at the discretion of the Federal Inspection (Brazil, 1997).

As a supplementary standard, MAPA allows carcass washing, depending on the extent of the contamination. The article 147 of the new RIISPOA also provides the possibility to take advantage of the carcass when the contaminated part could be completely removed. (MAPA, 1998; BRAZIL, 2017)

Factors associated with total condemnation by colibacillosis

Colibacillosis was an important cause of total condemnation of poultry carcasses in Brazil. It was highlighted in the states of BA (20.42%), MS (16.63%), SC (12.86%), TO (12.36%), and SP (8.74%).

According to Casagrande *et al.* (2017) colibacillosis is one of the leading infectious causes of total condemnation of poultry carcasses and is associated with systemic or localized infection caused by pathogenic avian *Escherichia coli*.

Rosa *et al.* (2019), emphasizes that colibacillosis has a great economic impact on poultry farming because it causes great mortality and reduces the productivity of poultry. Among the factors contributing to the development of the disease are the inadequate environment, respiratory diseases, biosafety failures, and health protocols, immunosuppressive factors and animal metabolism.

The control of this pathology can be accomplished through the management of environmental conditions, including humidity control, ventilation, and water chlorination. Management can be performed with antibiotics and preventive vaccination.

In the post-mortem inspection, the findings attributed to colibacillosis were defined by the macroscopic aspects of the lesions, which may manifest as fibrinous pericarditis, fibrous perihepatitis with an enlarged liver, hepatic congestion, and inflammation of the air sacs (Caldeira, 2008). For a definitive diagnosis, the use of microbiological techniques for isolation and identification of the agent would be necessary.

According to the technical regulation of the technological and hygienic inspection of poultry meat – SDA/MAPA, inflammatory processes such as arthritis, cellulitis, dermatitis, salpingitis and colibacillosis should be judged as follows: "Any organ or part of

the carcass that presents an inflammatory process should be condemned and, if there is systemic evidence of the problem, the carcass and viscera in their entirety should be condemned" (Brazil, 1998).

Factors associated with total condemnation by cachexia

Cachexia was a prominent cause among several states, ranking as the second leading cause in the states PA (23.46%), RS (15.25%), SP (12.64%) PE (12.58%) and ES (9.01%). In the State of Minas Gerais, it was the third leading cause of condemnation, with a 13.44% occurrence.

Paschoal et al. (2012) identified cases of cachexia as the third largest cause of total condemnation in the Northeastern PR, with a frequency of 15.82%. Compared to the results obtained in this study, the prevalence of cases of cachexia in relation to total condemnations in PR was 6.63% in the analyzed period.

RIISPOA determines that animals with cachexia should be condemned, regardless of the cause of malnutrition (Brazil, 1997). The new RIISPOA maintains the condemnation of carcasses with general changes as cachexia.

Freitas (2015) classifies cachexia as a pathology that can be characterized by the reduction of muscle mass, identified mainly in the pectoral muscles and body fat, being related to factors such as (i) problems in the digestive tract; (ii) nutritional, nozzle and poisoning problems; and among others that contribute to the animal having a dehydrated muscle and with discoloration.

Factors associated with total condemnation by excessive scalding

Excessive scalding composes a set of causes that are classified as

technopathies, as they are cases of carcass condemnations related to failure during animal slaughter procedures. Among the evaluated states, the ones with the highest prevalence records were PR (9.77%), TO (7.49%), MG (7.25%) and RS (7.21%).

Among the factors that contribute to the occurrence of total condemnations due to excessive scalding is the paralysis of the processing line, high water temperature and deregulated equipment, which causes the carcass to have a dry or cooked muscle texture and a whitish coloration in the lower chest (Brazil, 1998).

In the period from 2013 to 2017, carcasses with this type of alteration were sent to SIF and could be partially or totally condemned (Brazil, 1988). However, only extensive injuries should be totally condemned (Brazil, 2017).

Factors associated with total condemnation by ascitic syndrome

The cases of total condemnations for ascitic syndrome had a higher prevalence in the states of PR (11.97%), RS (8.99%), SP (8.82%) and MG (8.25%) (Tables 2 and 3) in the period from 2013 to 2017.

Ascitic syndrome has multifactorial origins, such as genetic, nutritional, management and environmental factors. They can be more frequent in cold times, due to the increase of pulmonary hypertension. In a study by Rosário et al. (2004), indicated that food restriction programs may contribute to the reduction of their occurrence. For Freitas (2015), ascitic syndrome is a pathology that could be associated with liver problems and tumors, where fluid accumulation occurs in the body cavity, mainly in the ventral region in birds.

In the legislation, the carcass presenting yellowish ascitic syndrome, with fibrin clumps, hemorrhage and/or adhesion of several organs should be

condemned (Brazil, 1998). The new RIISPOA, allows partial use, providing that the lesions are restricted to parts of the carcass. In cases of extensive lesions, they should be fully condemned. (Brazil, 2017).

Factors associated with condemnation by hemorrhagic viscera

The total condemnation of carcasses by hemorrhagic viscera was recorded only in the ES state, with a prevalence of 71.04% in relation to the total number of condemnations for the period from 2013 to 2017.

According to RIISPOA, carcasses that compromise the organoleptic aspects of the viscera should be condemned, Vieira-Pinto *et al.* (2003), associates this change with cases of coccidiosis.

According to Yang *et al.* (2019), coccidiosis in chickens is caused by protozoa of the genus *Eimeria spp* (subclass Coccidia) and are responsible for losses of approximately US \$ 3 billion annually in losses to the poultry industry due to high mortality and low growth. In addition to the low efficiency and disadvantages of anti-coccidial drugs and vaccines.

CONCLUSION

The federal inspection service is essential to ensure sanitary hygienic food quality standards offered to society. The economic loss of condemnations of poultry carcasses was estimated at the US \$ 175.56 million for the period from 2013 to 2017 in Brazil, in slaughterhouses under the supervision of SIF. Among the main causes, the Repugnant Aspect, Contamination, Colibacillosis, and Cachexia stand out. These losses can be minimized by taking care of sanitary and productive management in rural properties and in the processing stages in the industry. These actions can minimize the

producers' losses and contribute to the quality of the final product.

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