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Seizures of livers due to fasciolosis in cattle slaughtered in a slaughterhouse in Villa Clara, Cuba. 2016-2020

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Abstract

Fasciolosis is one of the most important causes of reduction in milk production, growth and fertility in cattle and causes considerable economic losses generated by liver seizures in slaughterhouses. The objective of this study was to determine the occurrence of livers seized by *Fasciola hepatica* in the Lorenzo Gonzales bovine slaughterhouse in Sagua la Grande municipality in Villa Clara province, Cuba. A retrospective observational analysis of the seizures of livers by F. hepatica in the period 2016-2020 was carried out. The prevalence, seasonality, trend and enzootic channels of the occurrence of livers seizures due to fasciolosis in slaughtered cattle were determined. In addition, the annual economic losses as a consequence of fasciolosis seizures were estimated. The sanitary impact of seizures due to fasciolosis showed a prevalence of 18.93%, which is a reflection of the epizootic situation of the units of origin. Losses due to liver seizures as a consequence of F. hepatica infestation amounted to 1 088 532 cup in the five-year period evaluated. The trend in the incidence of F. hepatica seizures is decreasing and shows a marked seasonal pattern in the months of March, April, May, June, October, November and December. The usual expected behavior of F. hepatica seizures of livers in the Sagua bovine slaughterhouse for a period of five years shows a wide range of monthly occurrences.

Keywords: Cattle; *Fasciola hepatica*; Losses; Prevalence; Sagua la Grande; Slaughterhouse

1. Introduction

Fasciola hepatica infections are considered as one of the most important causes of reduction in milk production, growth and fertility rates in cattle; in addition, it causes considerable economic losses generated by the seizure of liver in slaughterhouses so it has considerable negative impacts on animals, which is often difficult to quantify [1].

In Cuba, it is an enzootic disease of the livestock mass and is considered as the zoonotic disease of major economic importance affecting mainly cattle and sheep in both state and private sectors [2]. The economic losses that occur due to the seizure of livers affected by F. hepatica are relevant and depend on the interaction between the pathophysiological

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aspects of the disease and the environmental ones (climatological and geographical factors) that determine the presence of intermediate hosts and the parasite in the environment [3].

In Cuba, several studies have been carried out on the occurrence of fasciolosis in bovine slaughterhouses. In the province of Villa Clara, found 55% of livers seizures due to fasciolosis, 2.32% of hearts and kidneys seizures [4]. In studies carried out in Cuban livestock companies, economic losses were estimated at 16 121 30 USD due to seized livers affected by *F. hepatica* [5]. In three central provinces of Cuba, economic losses due to the seizure of livers were evaluated as considerable (436 656 USD) [6]. Also in a study conducted in the same region estimated losses of 16 12130 USD due to seized livers [7].

Arteaga. (2014) [8] demonstrated the existence of variability in the prevalence of F. hepatica, due to the influence of the year, the municipality of origin of the animals and climatic factors, fundamentally the average rainfall, in a bovine slaughterhouse in the province of Camagüey. In another study carried out in Villa Clara province covering five years, Lazo et al. (2017) [9] found 72.08% of pneumonia, 1.49% of mastitis and 24.05% of cirrhosis due to *F. hepatica* . In a study in two provinces of Cuba, they calculated losses that reached a value of 80 312 USD (Holguín) and 32 7152 USD (Camagüey) [3].

In the context of Latin America, several researchers have addressed the issue. In Bolivia, economic losses due to the seizure of livers infected with *F. hepatica* in slaughterhouses are of considerable importance [10]. In Costa Rica, the economic losses caused by the seizure of livers in slaughter plants were estimated in general terms according to the price at which the organs are sold in the market (Alpízar 2008) [11] and in another study the anatomo-histopathological lesions of bovine livers seized in slaughterhouses were analyzed [12]. In Peru reported that losses due to fasciolosis in cattle are in the millions [13]. In Brazil, addressed the spatial distribution of *F. hepatica* in cattle using Geographic Information Systems and logistic regression analysis [14]. In South America studied the epidemiology and control of Fasciolosis [15].

Observational analytical studies of the occurrence of *F. hepatica* liver seizures in slaughtered cattle complement field epizootiological studies and contribute to strengthen disease prevention and control programs. The association links between the areas of origin of slaughtered animals and the occurrence of seizures, allow establishing feedback to evaluate risk factors for the introduction and spread of diseases, as well as opportunities to mitigate their impact through early warning and timely response [9].

The objective of this study was to determine the occurrence of livers seized by *F. hepatica* in the Lorenzo Gonzales bovine slaughterhouse in Sagua la Grande municipality, Villa Clara province, Cuba.

2. Material and methods

The research was carried out in the Lorenzo Gonzales Slaughterhouse of Sagua la Grande municipality, belonging to the Villa Clara Meat Company. An analysis of data collection related to seizures of livers by *F. hepatica* in a time series of five years (2016-2020) was carried out through a retrospective observational analysis. The prevalence, seasonality, trend and enzootic carcasses of the occurrence of livers seizures due to fasciolosis in slaughtered cattle were determined. In addition, the annual economic losses as a consequence of fasciolosis seizures were estimated.

For the economic analysis of the results, the losses from seized livers were calculated, taking into account the selling price of 1 kg (29.89 cup).

To compare the percentage of the occurrence of seizures by year, a binomial proportion comparison test was performed. To study the trend component of the occurrence of seizures, the equation of the trend line adjusted by the least square method was found. To determine the presence of the seasonal component, an expectation curve was performed with the median monthly injury occurrence. The results obtained were processed using the statgraphics Plus 5.0 statistical package.

To establish the usual behavior channels of the occurrence of monthly seizures in the period analyzed, the median, first and third quartile method was used, which is based on determining for each period (months) a measure of central tendency and its minimum and maximum values, in order to define safety or alert zones. For this purpose, the median, minimum and maximum values of the occurrence of seizures of livers in each month of the five-year period of the time series analyzed were found, and the channels were constructed with the central measure, the lower range and the upper range, establishing the zones of success (values equal or lower than the lower limit), safety zone (values equal or lower

than the median and higher than the lower limit), alert zone (values equal or higher than the median and lower than the upper limit) and epizootic zone (values equal or higher than the upper limit).

2.1. Ethical aspects

The research was subject to ethical norms that made it possible to promote and ensure respect for all the participants in the study, so that their criteria/opinions and individual rights were respected, in order to generate new knowledge without violating the ethical principles of privacy and confidentiality of personal information of all the participants in the research. On the other hand, all authors involved in the research, publication and dissemination of the results are responsible for the reliability and accuracy of the results shown [16]. The cattle were slaughtered according to the Cuban standards of the National Center for Animal Health (CENASA) and the Terrestrial Animal Health Code, Chapter 7: Animal Welfare Law of the OIE.

3. Results

Table 1 reflects the economic-sanitary impact generated by liver seizures as a result of fasciolosis in cattle slaughtered at the slaughterhouse during the period 2016-2020.

Table 1 Economic-sanitary impact of livers seizures due to fasciolosis in Sagua la Grande slaughterhouse

Years	Animals slaughtered	Liver seizures	%	Losses (kg)	Importe (cup)
2016	18 507	2 993	16.17^{e}	6 663	199 157
2017	17 934	3 202	17.85^{dac}	6 269	187 380
2018	17 372	3 193	18.38^{bed}	7 727	230 960
2019	14 822	3 693	24.92^{ad}	9 649	288 408
2020	12 856	2 352	18.29^{c}	6 110	182 627
Total	81 491	15 433	18.93	36 418	1 088 532

Note: Unequal letters in the same column indicate significant differences for p≤0.05 by binomial proportion comparison test.

Of a total of 81 491 cattle slaughtered in the period analyzed, 15 433 livers with lesions compatible with fasciolosis were seized by the slaughterhouse health inspection services. This represented 18.93% (15 433/81 491) of the total number of livers, with losses of 36.4 tons of this edible viscera, which represents an economic loss of 1 088 532 cup (Cuban pesos). The percentage of livers seized increased from 2016 to 2019, the latter being the one with the highest losses 24.92% (3 693/14 822) with significant differences (p≤0.05) with the years 2016, 2018 and 2020 and 2016 the one with the lowest loss 16.17% (2 993/18 507) with significant differences with the rest of the years. This condition has a higher incidence, if it is taken into account that many livers with lesions compatible with *F. hepatica* but not compromising the whole organ, are recovered and do not count as seizures. Therefore, the real incidence is much higher than the apparent incidence or incidence counted by veterinary services.

As can be seen in figure 1, the occurrence of seizures of livers by *F. hepatica* in the time series period of the five years analyzed, has an irregular behavior, with peaks in the months of May 2016, March and November 2019 where the amount of this edible viscera seized was 391 457 and 543 respectively. The trend in the occurrence of liver seizures is decreasing.

When analyzing the behavior of the occurrence of seizures by month, in the period of the time series studied, through the analysis of a measure of central tendency (the median) it is evident that the months of April, May, June (rainy period) and October, November, December, March (not very rainy period) are the ones that show the highest number of seizures (Figure 2).

These results are attributed to the fact that in the months of April, May and June there is abundant rainfall, which favors the biotopes where the intermediate hosts of hepatic distomatosis proliferate and therefore a greater intensity of parasitic invasion, which is reflected clinically and lesionally in the following months. In addition, the months of October, November, December and March coincide with the period of low rainfall in Cuba and at this stage the organic defenses of the animals are weakened, and infectious and parasitic diseases increase, as well as deaths due to malnutrition. This

whole epizootiological scenario is reflected in the slaughterhouses where these animals arrive. On the other hand, in the last quarter of each year, more animals are slaughtered and, therefore, the probability of finding lesional findings of fasciolosis in cirrhotic livers is greater during this period of the year.

As shown in figure 3, the endemic channel or usual expected behavior for the occurrence of monthly liver seizures due to fasciolosis, in a period of five years in the Sagua bovine slaughterhouse, is from 199 to 332 affected livers per month. This denotes the high incidence of this affection in the bovine mass of the territory under study, which is reflected in the passive surveillance at the slaughterhouse level.

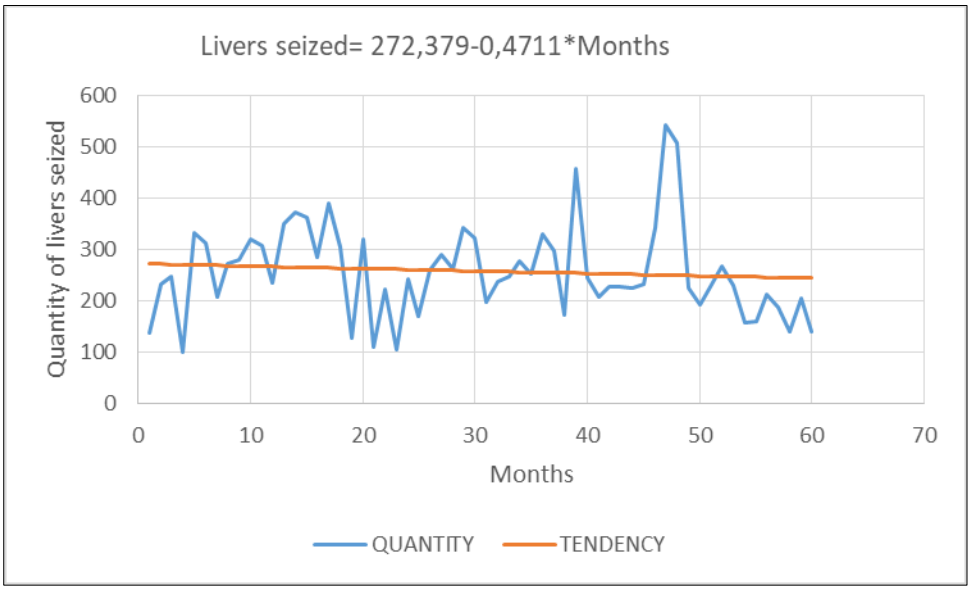

Figure 1 Trend of the occurrence of livers seizures due to fasciolosis in the period 2016-2020 in the Lorenzo Gonzalez slaughterhouse in Sagua la Grande, Villa Clara

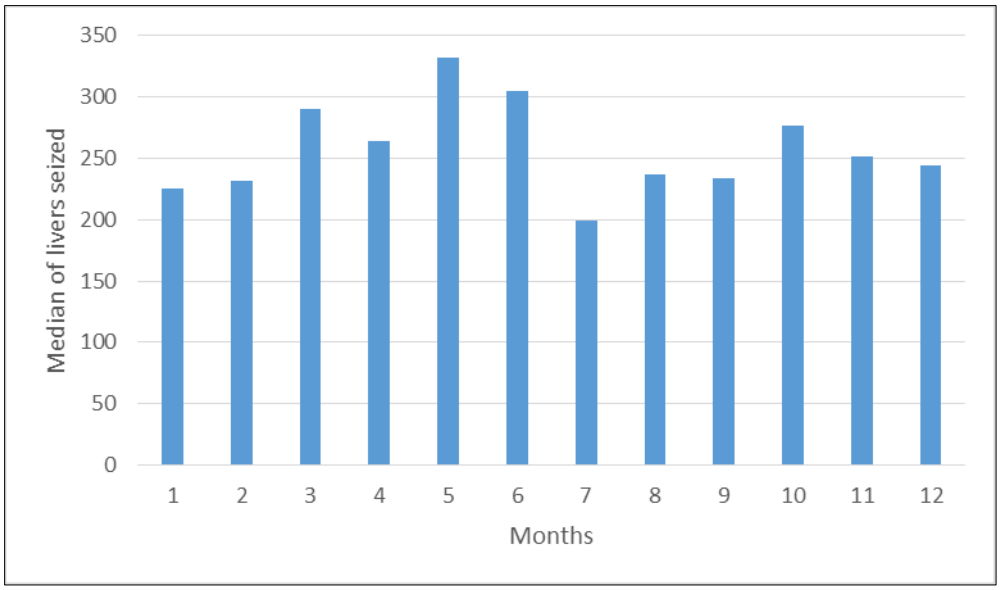

Figure 2 Seasonality of the occurrence of livers seizures due to fasciolosis in the Lorenzo Gonzalez slaughterhouse in Sagua la Grande, Villa Clara

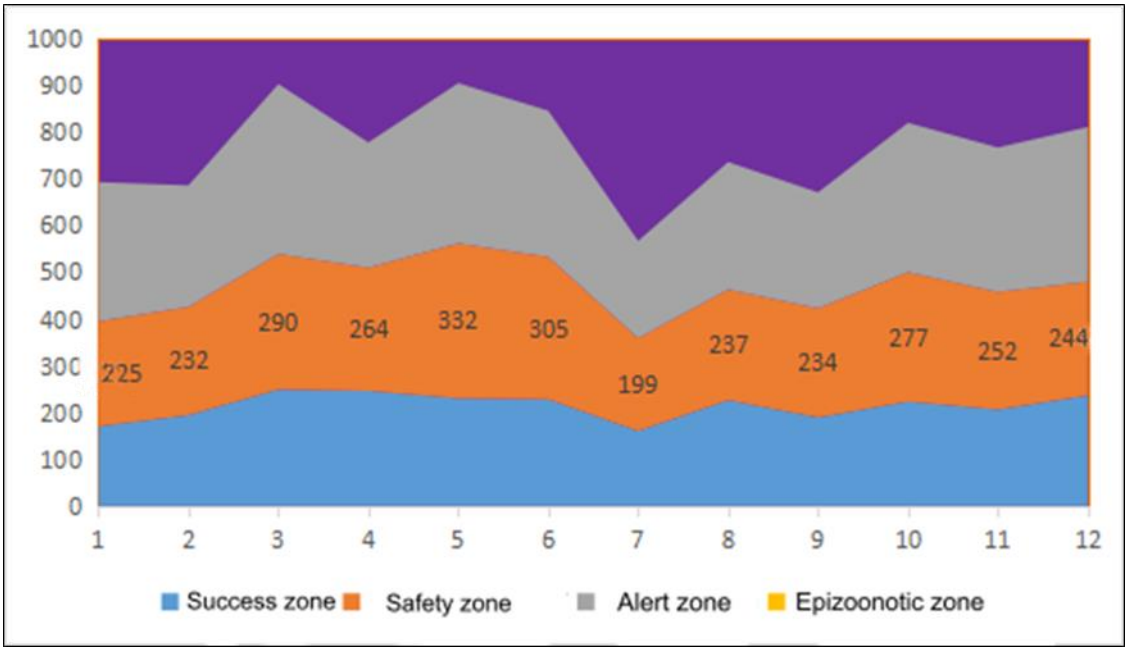

Figure 3 Channel of usual behavior of livers seizures due to Fasciolosis in the Lorenzo Gonzalez slaughterhouse in Sagua la Grande, Villa Clara

The establishment of the usual behavior channel constitutes an early warning system that allows the veterinary services to be informed of a possible eventuality regarding the appearance of outbreaks related to fasciolosis in cattle in the territory. This can be confirmed if the occurrence of liver seizures due to *F. hepatica* exceeds the usual range of behavior. This assertion is achieved by superimposing the data or records of the occurrence of seizures at a given time on the graph with the channels of usual behavior. One of the main objectives of surveillance systems is to generate information that allows early identification of changes in focal patterns of importance for the health of the herd. For this purpose, a useful tool is the so-called "enzootic corridor", which is the graphical representation of the current incidence over the historical one, which warns of a higher than expected incidence.

4. Discussion

With respect to the prevalence of liver seizures due to *F. hepatica*, the results of this study are lower than those obtained by Lima et al. (2005) [4], in the Commercialization Unit belonging to the Livestock Enterprise "The Vitrine" municipality of Corralillo, Villa Clara, Cuba, where 992 slaughtering's were analyzed in the year 2000 and 356 in the first quarter of 2001. The seizure of livers due to fasciolosis was 55% (548 livers) in 2000 and 54% (192 livers) in the first quarter of 2001; the seizure of hearts and kidneys represented 2.32% and 3.18% respectively of the total number of animals slaughtered. The main causes were fibrosis, cirrhosis, abscesses, telangiectasia and hepatic cysticercosis. They also differ from the findings in a study conducted in Colombia where they found 31.09 % of seizures due to *F. hepatica* in livers and 11.8% of pneumonias. In this study, it was found that the organ with the highest number of seizures is the liver with 67.94% of the total, followed by lung with 30.25% and heart 1.8% [17].

These results are attributed to the unfavorable epizootiological situation of cattle in the territory of origin. This situation allows inferring that there is a marked prevalence of fasciolosis and high intensity and extensiveness of parasitic invasion in the bovine population of the territory under study. It has been estimated that a quarter of the total population of sheep and cattle in the world graze in areas where *F. hepatica* is present and the environment is favorable for its maintenance and dispersal [18].

These results corroborate what was pointed out by Roque (2014) [19] who stated that Cuba has one of the most emerging problems to solve, the control of Fasciolosis in bovine livestock because statistically it has been shown that 35% of losses in adult cattle is caused by *F. hepatica*. In addition, the losses are much higher and still unaccounted for, taking into account the impact on milk production and meat conversion [6, 20].

Economic losses are lower than those reported by Espinosa et al. (2010) [13] in Peru, where the annual livestock loss due to fasciolosis is no less than US$ 50 million, estimated by the prevalence of infection and seizures of cattle livers in

slaughterhouses. The importance of this parasitosis in animals lies in the great economic losses it produces in affected cattle due to the decrease in productive parameters such as milk, meat, daily weight gain, lower number of weaned animals, the costs incurred for the purchase of medicines, and even the death of sick animals [21]. To this must be added the losses due to livers seized at slaughter and cattle classified as inferior quality [22, 23].

Studies carried out by Morales et al. (1996) [23], the largest seizures corresponded to liver with a total of 2 184 568 kg, which at a value of US$ 2.00 per kg, represents a loss of US$ 4 369 136. Dystomatosis presented the greatest number of kilos of liver seized, 1 370 894, which for this parasitism alone represented US$ 2 741 788, with the greatest loss in steers US$ 1 631 650 and cows US$ 629 214. As a result of other diseases affecting the liver (abscesses, fibrosis, hydatidosis, distomatosis, cirrhosis, angiomatosis), 76 897 kg were seized, which implied a loss of US$ 153 794. The main economic losses in the bovine species were due to the seizure of carcasses, liver and kidney.

We agree with Espinosa et al. (2010) [13] in relation to the more comprehensive assessment they make regarding the estimation of economic losses due to fasciolosis in cattle raising, when they point out that in their country (Peru), these are millions and difficult to estimate accurately, due to several factors such as the complex distribution of the parasitosis, the lack of an information system that provides the number of infected animals, the lack of knowledge of the treatment costs, as well as the decrease in productivity rates associated with this infection. An approximation to estimate the negative impact on the livestock economy is based on the number of livers seized and disposed of, which are recorded by the National Agricultural Health Service (SENASA). However, data such as losses in milk production, meat production, fertility reduction, death due to massive infections, use of anthelmintics, labor, among others, are not recorded. Therefore, estimates of economic losses based on the extrapolation of livers seized and disposed of in slaughterhouses are inevitably underestimated [13, 20].

In the economic field, losses due to seizure of red viscera (liver, heart, lung), reach important values even in developed countries where the seizure of Fasciola-infested livers is between 10 and 20% of the total number of animals taken to slaughter, rising between 45 and 55% in underdeveloped countries [17].

According to Novobilský et al. (2015) [24] and Correa et al. (2016) [25], the prevalence of this parasitosis in livestock farming worldwide causes great losses, due to the damage it causes, directly or indirectly, to milk and meat production, reproduction and the occurrence of other diseases, since the liver is primordial for most of the vital functions of animals and maintains a close relationship with the host immunity mechanisms.

The seasonality of the occurrence of liver seizures observed in this study does not correspond with those found by Cedeño et al. (2012) [17] in a study conducted in Colombia, where the maximum level of *F. hepatica* seizures was recorded in July and the lowest prevalence in April.

On the other hand, in the month of October, there is little rainfall and the drought leads to the forced shipment of animals in poor meat condition, many of them with chronic diseases that become evident or surface in unfavorable conditions such as those of the dry period.

5. Conclusion

The sanitary impact of seizures due to fasciolosis showed a high prevalence, which is a reflection of the epizootic situation of the units of origin, where the tendency of the incidence of seizures due to *F. hepatica* is decreasing, with a marked seasonal pattern in the months of March, April, May, June, October, November and December. Losses due to liver seizures as a consequence of *F. hepatica* infestation can be considered high during the five years evaluated.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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