

Prevalence of bovine cysticercosis of slaughtered animals in south and southeast at state of Goiás, Brazil

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Abstract— Bovine cysticercosis is a zoonotic disease globally distributed that causes serious problems of public health and economic consequences. This parasitic disease is caused by species *Taenia saginata*, and the cattle as intermediate hosts, causing bovine cysticercosis, and human definitive host, causing taeniasis. The main symptoms of taeniasis are: malnutrition, intestinal obstruction, abdominal pain, anal itching, among others. In this sense, this study aimed determine prevalence of bovine cysticercosis in animals from southern and southeastern Goiás slaughtered at different slaughterhouses from 2004 to 2008, inspected by State Inspection Service (SIE) and Federal Inspection Service (SIF). For SIE, were surveyed 18 cities in south and southeast of Goiás, in the period 2005 to 2008, which 4927 animals were slaughtered, these 411 were positive for cysticercosis, revealing a prevalence of 8.3%, demonstrating endemicity of region. The inspection was carried out by SIF in the period 2004 to 2007 in 20 towns in south and southeast. From 300,825 slaughtered animals, 1731 were positive, establishing a prevalence of 0.5% for cysticercosis. Despite did not identify prevalence of endemic, some cities, when analyzed, proved to be endemic, such as Santa Cruz (8.5%), Cumari (6.5%) and Orizona (6.2%). According to the findings, appears that south and southeast of Goiás requires implementation of health education programs so that cycle is interrupted.

Keywords— *Taenia saginata*, Bovine cysticercosis, Slaughtered animals, Zoonotic disease.

I. INTRODUCTION

Taeniasis-cysticercosis complex has global distribution, demonstrating significative impact in public health, and registering serious economic losses in some countries, considered as a matter of food security [1].

T. saginata occurs in small intestine of humans who are the definitive host of this tapeworm. Humans get infected by eating raw or undercooked meat containing viable cysticerci. The tapeworm develops in small intestine and becomes sexually mature in about 3 months, producing gravid proglottids, which are mobile and either migrate from the host's anus spontaneously or are shed in faeces [2, 3]. The presence of tapeworm in intestine can cause some abdominal discomfort, mild diarrhoea, weight loss and pruritus caused by migrating proglottids [4].

Prevalences in humans are highly variables within a country and between countries. This variability in prevalence

is due to hygienic habits, quality of meat inspection and culinary habits. However, human taeniosis is not a notifiable disease and reported prevalences are only indicative [5].

T. saginata is a tapeworm of humans with a global distribution and causing low morbidity [6]. Bovine cysticercosis is an important public health and economic problems caused by its consequence on public health nutrition and economy of some countries [7, 8].

Currently diagnosis of bovine cysticercosis is performed in slaughterhouses, during the post-mortem examination of housing, based on observation of metacestode tissue. Currently, records of cattle raised by the inspection of meat, still common in many locations worldwide [9 – 13]. It should be noted that the inspection of meat in slaughter establishments in Brazil is still performed under different conditions, being made in the municipal, state and refrigerated slaughterhouses with Federal Inspection Service

for export and domestic trade. These differences are directly related to the requirements of the consumer market and the technical-financial and staffing of each unit. It is known that only inspection of carcasses carried out by technical inspection are not fully effective, because for reasons of aesthetic and commercial, are not usually shredded all the organs, viscera and carcass muscle [14].

In Brazil were reported prevalence of bovine cysticercosis in the following locations: California-2, 79% [15], Guarulhos, SP-10, 7% [16], Mato Grosso do Sul-1, 04% [17], Rio de Janeiro-5, 81% [18]. In Rio Grande do Sul bovine cysticercosis is the main cause of retention of carcasses in slaughterhouse under federal inspection [19].

The main town of Triângulo Mineiro, Uberlândia, located about 70 km from the border with southeastern Goiás, was found in a study on last bovine cysticercosis was carried out between the years 1979 to 1993 a rate of 1.87% [20].

Midwest and Southeast account for nearly 58.5% of the slaughter of cattle in Brazil. Mato Grosso is central Brazilian state in volume of slaughter, 13.6% of all domestic production made by establishments inspected. Then there are productions made in Sao Paulo (13.3%), Mato Grosso do Sul (12.2%) and Goiás (9.2%) [21].

There is a lack of current data to determine epidemiological profile of cattle raised in Brazil. In the specific region of south and southeast Goiás no exist data on prevalence of this zoonosis. The importance of understanding the complex Taeniasis-cysticercosis because it is a zoonosis and the establishment of infection is heightened by poor health, creating a public health problem, justify the need for a study to determine the prevalence of bovine cysticercosis in region.

The objectives of this study was to determine prevalence of cysticercosis in cattle slaughtered in different slaughterhouses in southern and southeastern Goiás monitored by the State Inspection Service (SIE) from 2005 to 2008 and analyze the frequency of infections viable and calcified in metacestode *T. saginata*.

II. MATERIAL AND METHODS

Study Area

In order to inspect and review, the Defense Agency of Goiás Corporation (AGRODEFESA) divides state into 12 regions: Chapada dos Veadeiros/Alto Paraíso, Entorno/Formosa, Vale do São Patrício/Goianésia, Metropolitana/Goianá, Estrada de Ferro/Catalão, Caiápo/Iporá, Alto Araguaia/Jataí, Rio

Vermelho/Mozarlândia, Sul/Itumbiara, Norte/Poranguatu, Nordeste/Posse e Sudoeste/Rio Verde [21].

This study was conducted at Regional Estrada de Ferro/Catalão, composed of 22 municipalities in the south and southeast of the state of Goiás at southeast region consists of 26 municipalities spread over an area of 25,122.039 km², corresponding to 7, 39% compared to state, its population density is 15.22% inhabitants/km² (SEPLAN-GO, 2006). This study analyzed data from three municipalities of southern region (Caldas Novas, Marzagão and Rio Quente). In this study we considered data from 19 municipalities in the Southeast., The main city region is Catalão, located at 18 ° 10 '05 "S and 47 ° 57 '19" W, and 300 km from Brasília. The city's population is estimated at 75,623 inhabitants. The Gross Domestic Product (GDP) of more than 2.5 billion reais, the city ranks as the sixth largest economy in Midwest of Brazil and the third of Goiás About 80% of its population live in urban area and 20% live in the countryside. In 70's the rural area had 44% of the population of the municipality and due to the strong process of urbanization, rural population decreased to 10.48% [22].

Population Study

The study was conducted in 4927 cattle slaughtered on farms in south and southeast of Goiás, supervised by the State Inspection Service (SIE). Municipalities cedes are: Anhanguera, Caldas Novas, Campo Alegre, Catalão, Corumbalpa, Cristianópolis, Cumari, Davinópolis, Goianíara, Ipameri, Marzagão, Nova Aurora, Orizona, Ombudsman, Palmelo, Pires do Rio, Rio Quente, Santa Cruz, São Miguel do Passa Quatro, Três Ranchos, Urutai and Vianópolis.

Collected Data

In order to perform an epidemiologic history of cattle raised in south and southeast at state of Goiás, slaughter data were provided by AGRODEFESA in accordance with routine inspections conducted by the organ of State Inspection Service (SIE) for the period 2005 to 2008.

Inspection of post-mortem carried out by the SIE is visual, preceded by several incisions 0.5 cm in each organ (heart, diaphragm, shoulder, tongue, liver, kidneys, lungs and muscles) to examine positivity or negativity of metacestodeos *T. saginata* in animals. Monthly and annual reports are filled by the attending veterinarian and his team, from records collected daily, providing various information relating to the slaughter. These data are sent to the Ministry of Agriculture, Livestock and Supply-MAP. The procedures used in routine inspections are conducted in accordance with

the stipulations of Article 176 of the Rules of Industrial and Sanitary Inspection of Animal Products-RIISPOA.

Data analysis

The positivity of cattle raised in the period analyzed, the city of origin and viability of infection was calculated using Graphpad Prism version 5.0 using the Chi-square.

All results were considered statistically significant at a significance level of 5% ($p < 0.05$).

III. RESULTS

In period of 2005 to 2008, were inspected by the SIE, 18 of the 22 cities in the region. During this period, 4927 animals were slaughtered, these 411 were infected with metacestodes of *T. saginata*. In 2005 there was the most positive 11.5%. This difference was statistically significant when compared to years 2006 and 2007 (Figure 1).

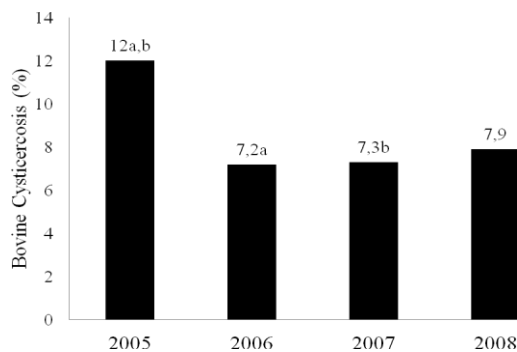


Fig.1 - Incidence of cysticercosis Bovine reviewed by the SIE in the period 2005 to 2008. a ($p = 0.0058$) b ($p = 0.0063$).

Can be seen in Table 1, the prevalence of cysticercosis in municipalities of origin of animals slaughtered per year. In 2005, no area showed a significant difference in distribution of bovine cysticercosis.

In 2006, Cristianópolis showed lowest prevalence, statistically significant when compared to other locations. The highest estimated prevalence in that year was 23.1% in São Miguel do Passa Quatro. This prevalence was statistically significant when compared to Catalão city ($p = 0.0261$), Cristianópolis ($p < 0.0001$) and Cumari ($p = 0.0359$).

In 2007 was recorded prevalence of 25% in São Miguel do Passa Quatro. This prevalence was statistically higher when compared to Catalão city ($p = 0.0002$), Goiandira ($p = 0.0065$) and Urutaí ($p = 0.0302$).

The higher prevalence in 2008 was recorded in municipality of Ipameri (17.9%). This difference was statistically significant in comparison to Catalão ($p =$

0.0004), Davinópolis ($p = 0.0140$), Santa Cruz ($p = 0.0082$) and Vianópolis ($p = 0.0013$).

Analysis of cattle raised during the four years showed that the city of São Miguel do Passa Quatro obtained highest prevalence (28.8%) compared to cities in Catalão ($p < 0.0001$), Cristianópolis ($p < 0.0001$), Davinópolis ($p = 0.0063$), Goiandira ($p = 0.0013$), Ipameri ($p = 0.0350$), Nova Aurora ($p = 0.0193$), Orizona ($p = 0.0322$), Ombudsman ($p = 0.0018$), Santa Cruz ($p = 0.0252$), Urutaí ($p = 0.0059$) and Vianópolis ($p = 0.0046$).

Routine inspection of SIE analyzes type of infection of metacestodes of *T. saginata*, classifying it into viable infection or calcified. Analyzing data provided there was no statistical difference in relation to infection (Figure 2).

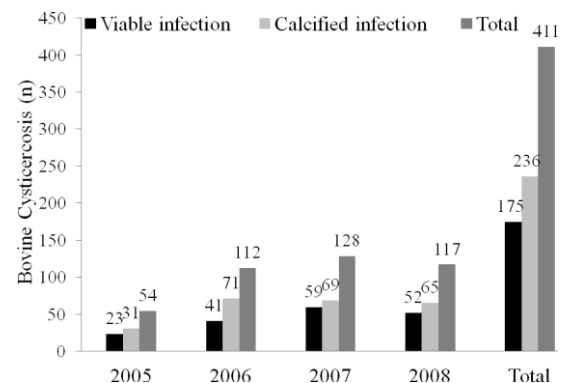


Fig.2 - Distribution of infections, classified into viable and calcified, with respect to municipalities in south and southeast of Goiás, in the period 2005 to 2008, according to the SIE.

Despite the year 2007 had highest infection rate feasible, there were no statistical differences regarding distribution of annual and local infections.

IV. DISCUSSION

Complex Taeniasis-cysticercosis is a serious public health problem in many parts of the world, including Brazil. In places where infection is endemic, the transmission is related to poor hygiene and poor sanitation, especially in rural areas [25]. For Pan American Health Organization and World Health Organization, a region is considered endemic for taeniasis when its prevalence is greater than 1% to 0.1% human cysticercosis and cysticercosis animal 5% [26, 27].

The classification of a region as endemic for bovine cysticercosis is a serious public health issue, because as to be defiled, these animals had contact with human feces contaminated. An endemic area for cattle raised as it is for human taeniasis [28]. The filing of this complex in a region

indicates that sanitation and health education are disabled, proving the need for programs of intervention by public health authorities.

T. saginata taeniasis is not subject of great concern as the taeniasis by *T. solium*, since the latter can cause human cysticercosis accidental. However, the taeniasis, independent of the ethological causes the host abdominal discomfort, diarrhea, weight loss and itching due to migration of gravid [4]. In areas where malnutrition is a factor of concern in public health, the presence of taeniasis aggravates the situation because of the spoliation of the host by the parasite [12, 13, 28, 29]. Transmission by *T. saginata*, between humans and cattle, generally are related to the primitives practices of animal creation, inadequate meat inspection, poor sanitation, and the deficiency in control policies or management [30] prove need of programs of intervention by public health authorities.

Mandatory reporting helps to identify and thus control of various diseases. In Brazil, for the complex Taeniasis-cysticercosis, mandatory reporting is done only some states and not for human cysticercosis [31]. Notification shall extend to entire national territory, covering all the infections present in the cycle. This procedure maps, reliably, the complex parasitic in the country, thus enabling their control and preventing its spread to non-endemic regions and other countries.

Specifically regarding bovine cysticercosis, the biggest concern for refrigerators and producers are economic consequences generated by condemnation of carcasses contaminated by restricting its marketing in foreign market [32].

Disease most commonly diagnosed during slaughter of cattle is cysticercosis, this problem intensifies in Brazil which has second largest cattle herd and slaughter in the world with about 200 million head. Cysticercosis is a disease most commonly diagnosed during slaughter of cattle and is a major cause of condemnation of the Federal Inspection Service oversees 49% of slaughtered animals [33].

Since complex Taeniasis-Cysticercosis causes economic problems, social and public health data on its actual occurrence is of paramount importance. However, in Brazil, despite record of inspection bodies, there are few studies that evaluate and compare the actual distribution of this disease. In the State of Goiás, in particular, there are no records of studies prevalence of bovine cysticercosis, thus preventing comparison of results in this study with similar studies.

Meat inspection at state of Goiás is performed by different institutions. The authors analyzed data for review

by the SIE. Meat inspection at state of Goiás is performed by different institutions. Authors analyzed data for review by the SIE. Results regarding prevalence of total and specific each municipalities, qualified as a region endemic for cysticercosis.

Years 2006 and 2007 demonstrated decreased prevalence of bovine cysticercosis, which may indeed be associated with improvements in farming conditions and conscience health. However observed was an increase in the year 2008 and to be carefully examined by the public health.

Another aspect to be considered is classification held by SIE, the viability of infection, since this is related to continuity of parasitic cycle. Analysis of results shows no difference between viable and calcified infections, but further action in relation to this analysis must be taken. It is suggested, the inspection services, the quantification of metacestodes found and determining its feasibility. This will allow analysis of parasite load of infection, which implies virulence of parasite and host immunity. It will also make sure that infection is only by viable or calcified metacestodes.

Sanitary inspection of meat held in refrigerated slaughterhouses is an important preventive method, preventing carcasses unfit for human consumption are marketed [35]. Despite limitations related to inspection, it is an important and specific diagnosis of bovine cysticercosis, it identifies carcasses with massive infections and lightweight, and serves as an indicator of the degree of infection in a region [36].

Thus, inspection services work not only as supervisory body, but also as keepers of data centers for disease of great public health importance. Your contribution is vital epidemiological, but the lack of proper analysis, these data may be lost unexplored, as might be used in epidemiological mapping local, state and national diseases frequently, helping to develop programs of prevention and control of zoonoses more frequently in the country.

In this scenario, is essential to exchange of information between oversight bodies and institutions of education and research. Thus allowing the creation of alternatives for data collection and analysis more specific seasonal results, limiting the actual profile of the cattle raised in region, aiming at developing health measures to stop the disease cycle.

Only service of meat inspection is not sufficient and calls for the installation of preventive measures in farms where the animals are raised, involving the handling of animals and education of health professionals related to creation.

V. CONCLUSIONS

Owing to difficulty of diagnosing cysticercosis before slaughter and inspection of animals is also needed, creation of public policies, as eradication is virtually impossible to consider a country like Brazil where there are many social differences divided into an immense territorial extension.

The prevalence of 8.3%, found in cattle monitored by the SIE in the period 2005 to 2007, characterized south and southeast of Goiás as endemic for bovine cysticercosis. No statistical difference was found between frequencies of infection by viable and calcified metacestodes of *T. saginata*. It is necessary partnership between educational institutions and research with inspection services (municipal, state and federal) to determine the actual prevalence of bovine cysticercosis in country and develop strategies to interrupt cycle of this disease.

CONTRIBUTORS

NA developed study idea and design, performed study and manuscript design.

LR and TSO contributed with script and preparation of manuscript.

HB conceived study, assisted in experimental design, and helped draft the manuscript. All authors read and approved the final manuscript.

CONFLITS OF INTERESTS

Authors do not have any conflicts of interests based on the presenting information and data. In addition, authors do not have any financial competing interests.

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Table 1 - Distribution of bovine cysticercosis in the region south and southeast Goiás state, according to the SIE, between the years 2005 to 2008.

Municipalities	2005		2006		2007		2008		Total	
	Slaughter	Positive % (n)	Slaughter	Positive % (n)	Slaughter	Positive % (n)	Slaughter	Positive % (n)	Slaughter	Positive % (n)
Caldas Novas							20	10 (2)	20	10 (2)
Campo Alegre de Goiás							18	5,5 (1)	18	5,5 (1)
Catalão	5	20 (1)	190	5,2 (10) ^a	1	3,5 (9) ^a	240	5 (12) ^{a,e}	436	4,6 (32) ^a
Corumbaba					20	5 (1)	20	15 (3) ^f	40	10 (4)
Cristianópolis			200	1 (2)*					200	1 (2) ^a
Cumari			100	5 (5) ^b	20	5 (1)			120	5 (6) ^a
Davinópolis							60	3,3 (2) ^a	60	3,3 (2)
Goiandira			189	0,6 (13)	180	5,5 (10) ^c			369	6,2 (23) ^a
Ipameri	23	13 (3)	160	0,9 (15)	282	7,8 (21)	117	17,9 (21) ^a	582	10,3 (60) ^a
Nova Aurora			60	6,6 (4)	20	25 (2)	20	5 (1)	100	7 (7) ^a
Orizona	132	10,6 (14)	132	10,6 (14)	104	6,4 (9)	81	9,8 (8)	449	10 (45) ^a
Ouvidor					115	4,3 (5)			115	4,3 (5) ^a
Pires do Rio	219	12,7 (28)	218	11,4 (25) ^a	419	10,2 (43) ^a	403	12,4 (50) ^e	1259	11,6 (146)
Santa Cruz de Goiás	40	10 (4)	48	14,5 (7) ^a	35	11,4 (4) ^a	90	4,4 (4) ^a	213	8,9 (19) ^a
São Miguel do Passo			13	23,1 (3) ^{a,b}	20	25 (5) ^{a,b,c}			33	24,2 (8) ^a
Quatro										
Vianópolis			22	13,6 (3)	25	12 (3)	103	2,9 (3) ^{a,e,f}	150	6 (9)
Total	449	12 (54) ^g	1501	9,1 (112) ^g	1435	7,5 (128) ^g	1286	9,09 (117)	4671	8,3 (411)

* Lower prevalence of bovine cysticercosis ($p < 0,05$) a , e, f, g ($p < 0,05$); b ($p = 0,0359$); c ($p = 0,0065$); d ($p = 0,0302$).* Lower prevalence of bovine cysticercosis ($p < 0,05$) a , e, f, g ($p < 0,05$); b ($p = 0,0359$); c ($p = 0,0065$); d ($p = 0,0302$)