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Análisis de indicadores epidemiológicos: Brucelosis bovina en la Costa Atlántica y Antioquia - Colombia, 2005-2013

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ABSTRACT:

Objective. Describe the situation of the bovine brucellosis in the Atlantic Coast and Antioquia (CAA) by analysis of epidemiological indicators during 2005-2013. **Material and methods.** The data was obtained from epidemiological reports of the Colombian Agricultural Institute and the National Agricultural Census 2014. The annual departmental average of the variables studied was compared and it was performed a temporal analysis through graphical representation. **Results.** 44% of the positive farms were focused on the CAA; the positivity rate of farms in the CAA (27.9%) was higher and statistically significant when related to the average rate in the country (24.8%) being promoted by the least producing departments. Regarding to the cattle population, the CAA concentrated 47.0% of positive cattle in the country; however, the bovine positivity rate (5.8%) was statistically equal to the national average (5.3%); yet, the departments with lower cattle population had the highest rates. The best surveillance for bovine brucellosis was observed between 2005 and 2009, in contrast, during 2010, 2011 and 2013 there was a considerable reduction in the number of diagnoses, in both farms and cattle. In the least producing departments the temporary distribution of epidemiological indicators favored more the presence of the disease. **Conclusions.** The National Prevention Control and Eradication Program of Bovine Brucellosis in the CAA presented promising results, however, the lack of continuity in the diagnostic surveillance during some years and mainly in the least producing departments affected negatively their development.

KEYWORDS: Bovine, *Brucella abortus*, epidemiological surveillance, prevalence (Fuente: DeSC).

RESUMEN:

Objetivo. Describir la situación de la brucelosis bovina en la Costa Atlántica y Antioquia (CAA) mediante análisis de indicadores epidemiológicos durante el periodo 2005 – 2013. **Material y métodos.** Los datos fueron obtenidos de boletines epidemiológicos del Instituto Colombiano Agropecuario y del Censo Nacional Agropecuario 2014. Se comparó la media departamental anual de las variables estudiadas y se realizó un análisis temporal por representación gráfica. **Resultados.** 44% de los predios positivos se concentraron en la CAA; la tasa de positividad de predios en la CAA (27.9%) fue mayor y altamente significativa en relación a la tasa media del país (24.8%) siendo promovida por los departamentos menos productores. En relación a la población bovina, la CAA concentró 47,0% de los bovinos positivos en el país; no obstante, la tasa de positividad bovina (5.8%) fue estadísticamente igual a la media del país (5.3%), los departamentos con menor población bovina presentaron las mayores tasas. La mejor vigilancia

para brucelosis bovina se observó entre 2005 y 2009, contrariamente, durante 2010, 2011 y 2013 hubo reducción considerable en el número de diagnósticos, tanto en predios como en bovinos. En los departamentos menos productores la distribución temporal de los indicadores epidemiológicos favoreció más la presencia de la enfermedad. Conclusiones: El Programa Nacional de Prevención, Control y Erradicación de la Brucelosis Bovina en la CAA presentó resultados promisorios, sin embargo, la falta de continuidad en la vigilancia diagnóstica en algunos años y principalmente en los departamentos menos productores afectó negativamente su avance.

PALABRAS CLAVE: *Brucella abortus*, bovinos, vigilancia epidemiológica, prevalencia (Fuente: DeSC).

INTRODUCTION

Brucellosis Is a global zoonotic disease, Its etiological agent was discovered in 1887 by Bruce (1). Bovine brucellosis produced by the *Brucella abortus* species affects cattle of all ages, buffalo, sheep, goats, horses and pigs are also vulnerable to it. Bovine brucellosis is a disease of official control and mandatory reporting (2). In Colombia, the National Program for Prevention, Control and Eradication of Bovine Brucellosis is regulated by resolutions 550 of 2006, 1332 (which repeals Decree 840 of 2011) and 1385 of 2013 (3,4,5).

The National Program for Prevention, Control and Eradication of Bovine Brucellosis in Colombia aims to reduce the appearance of the disease and further achieve its eradication. Specifically, the program aims to implement better diagnostic methods to recognize the epidemiological situation of the disease in Colombian livestock, to protect the vulnerable bovine population through vaccination of calves, to promote control in dairy industries, and to establish ranches and areas free of brucellosis (4). The knowledge of the health status of bovine brucellosis, along with the analysis of its epidemiological surveillance, are fundamental aspects to guide its eradication and continue to overcome international trade barriers.

Although there is progress in the international trade of Colombian livestock, bovine brucellosis continues to generate great economic loss in production and represents a serious public and animal health problem. In the year 2013, ICA analyzed 749,220 bovine serological tests belonging to 32,872 farms, with a 3% positive result in cattle and 23% positive result in farms; An additional study in 112 farms determined a prevalence of 19%. In the same year, the ICA identified 56 positive human samples in the departments of Arauca, Atlántico, Bolívar, Caldas, Caquetá, Casanare, Cesar, Meta, Nariño, Sucre and Tolima (6).

The Atlantic Coast and the department of Antioquia sum up to 23.1% of the total pasture area in Colombia; In addition, in the Atlantic Coast, cattle ranching in the department of Córdoba occupies the second national position after the department of Antioquia (7). In the Atlantic Coast, a prevalence of 2.6% has been determined in cattle and 25% in farms (8). Cattle raising in the department of Córdoba has reported prevalences of 3.7% in animals and 12.7% in farms (9).

Previous studies have not considered the effectiveness of the bovine brucellosis surveillance system. The objective of this study was to describe the epidemiological situation of brucellosis in the Colombian Caribbean Region and the department of Antioquia and analyze the management of the official surveillance system during the period 2005-2013; The results contribute to better targeting in the planning of control and eradication measures.

MATERIALS AND METHODS

Study area. The study area included the Atlantic Coast and the department of Antioquia - CAA (Figure 1). The Atlantic Coast comprises the departments of Atlántico, Bolívar, Cesar, Córdoba, Guajira, Magdalena and Sucre; The department of Antioquia, although belonging to the Andean region, was added to the study because of its significant cattle population and its proximity to the departments of Bolívar and Córdoba.

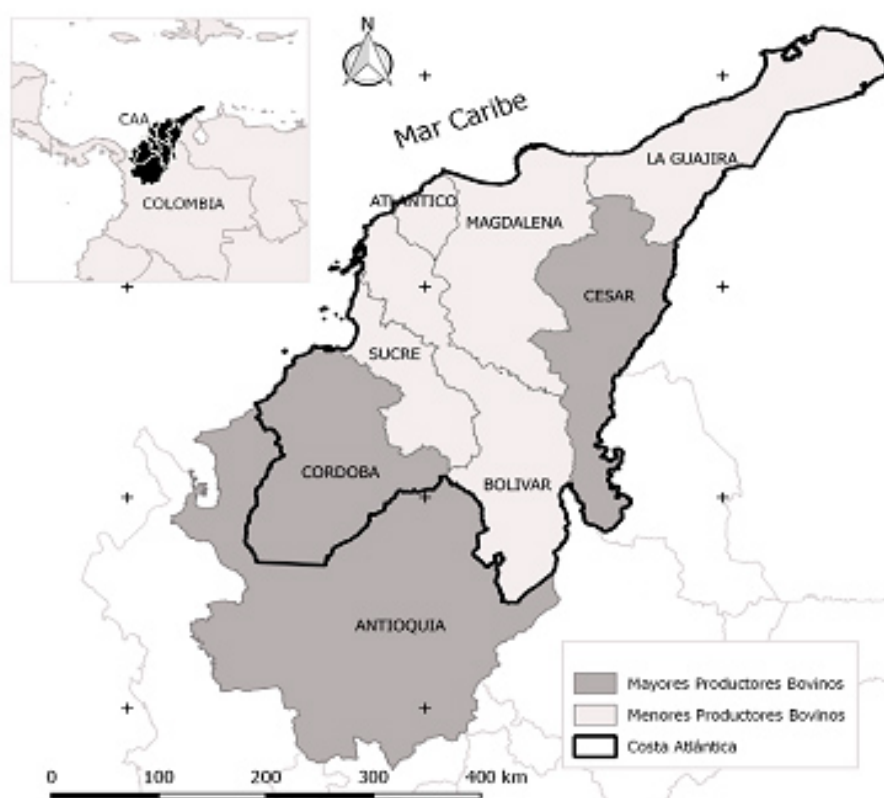


Figure 1. Map identifying the area of study included the departments of the Atlantic Coast and the department of Antioquia (CAA).

Data. The study was developed as of the epidemiological reports from the Colombian Agricultural Institute (ICA). Data was obtained from the annual epidemiological bulletins (10) and corresponds to bovine diagnoses with suspected brucellosis in CAA departments during the period of 2005-2013. The samples represented epidemiological surveillance in the different municipalities of each department of The CAA. In addition, data was taken from the National Agricultural and Livestock Census for the number of farms and the bovine population in the analyzed departments (7).

The analyzed variables were: positive locations (PPos), rate of property positivity (TPosP), land surveyed (PExa) and land survey rate (TDP); Bovine positivity (BPos), bovine positivity rate (TbBB), bovine examined (BExa) and bovine diagnosis rate (TDB).

A comparative description was initially made between the annual departmental mean (MDA) for these variables during the study period. Regarding the farms, the MDA was obtained by the following equations:

$$MDA_PPos = (\sum PPos) / n$$

$$MDA_TPosP = (\sum TPosP) / n \text{ where, } TPosP = PPos / PExa * 100$$

$$MDA_PExa = (\sum PExa) / n$$

$$MDA_TDP = (\sum TDP) / n \text{ where, } TDP = PExa / (\text{Total farms}) * 100$$

The relationship between the MDA and the animal population was obtained through the following equations:

$$MDA_BPos = (\sum BPos) / n$$

$$MDA_TPosB = (\sum TPosB) / n \text{ where, } TPosB = BPos / BExa * 100$$

$$MDA_BExa = (\sum BExa) / n$$

$MDA_TDB = (\sum TDB)/n$ where, $TDB = BE_{\text{Exa}} / (\text{Total bovinos}) * 100$

Later, a temporal analysis was performed through graphical representation of the studied variables. Correlation and comparison tests of means were also applied in the results analysis.

RESULTS

According to data from the National Agricultural and Livestock Census 2014, out of 646,463 farms or Agricultural Productive Units (UPAs) that own cattle in Colombia, 163,138 (25.2%) correspond to the CAA region, these farms have 42.2% (9,084,135 bovines) Population of the country (CNA, 2014). In Table 1, the total number of farms that have cattle and total cattle in Colombia and in the departments of the CAA region is presented; Additionally, the amount and the MDA of farms and cattle that tested positive and their corresponding positivity rates are shown.

Table 1. Statistical summary with the total and MDA for the variables related to diagnostic coverage and positivity to brucellosis in cattle of the CAA during the period of 2005 - 2013.

Variables	Colombia	CAA	Antioquia	Córdoba	Cesar	Magdalena	Bolívar	Sucre	Guajira	Atlántico
TOT Predios	646.463	163.138	49.945	24.939	11.840	18.134	20.848	17.296	13.062	7.074
TOT PExa	263.803	105.573	55.502	25.887	7.272	3.001	3.852	7.054	1.036	1.969
TOT PPos	62.364	27.441	13.244	7.077	1.927	1.209	1.174	1.918	285	607
MDA PExa	916	1.466	6.167	2.876	808	333	428	784	115	219
MDA PPos	217	381	1.472	786	214	134	130	213	32	67
MDA TPosP	24.8	27.9	25.2	24.9	24.8	34.8	29.5	24.7	27.5	31.6
MDA TDP	5.1	5.4	12.3	11.5	6.8	1.8	2.1	4.5	0.9	3.1
TOT Bovinos	21.502.811	9.084.135	2.289.770	1.956.117	1.446.184	1.138.740	885.113	823.131	329.571	215.509
TOT BE _{Exa}	4.247.331	2.438.237	947.451	542.880	447.151	125.985	127.006	166.104	26.547	55.113
TOT BPos	215.006	100.949	39.227	25.517	10.179	8.110	5.655	8.402	1.001	2.858
MDA BE _{Exa}	17.030	33.860	105.272	60.320	49.683	13.998	14.112	18.456	2.950	6.124
MDA BPos	741	1.402	4.359	2.835	1.131	901	628	934	111	318
MDA TPosB	5.3	5.8	4.6	5.2	2.9	13.8	5.4	4.5	4.1	5.6
MDA TDB	2.7	2.5	4.6	3.1	3.4	1.2	1.6	2.2	0.9	2.8

During the period between 2005 and 2013 in Colombia, 44.0% of the 62,364 PPos to Brucella were concentrated in the CAA, with a notable outpost in the departments of Antioquia (13,244) and Córdoba (7,077); The PPM MDA in these departments (1,472 and 786, respectively) was above the country (217) and the Region (381) average.

TPosP in the CAA was higher (27.9%, 95% CI: 25.76 - 30.02) and highly significant ($t = 2.9068$, $gl = 71$, $p\text{-value} = 0.0049$); The departments of Magdalena (34.8%), Atlántico (31.6%) and Bolívar (29.5%) significantly affected the value in the region; Contrarily, Antioquia and Córdoba presented high PExa MDA and low TPosP compared to the region.

Regarding TDP, the average for the country was 5.1% and the CAA was 5.4%. The departments of Antioquia (12.3%) and Córdoba (11.5%) largely exceeded these values, showing a greater epidemiological surveillance at a farm level; On the other hand, the departments of Guajira, Magdalena, Bolívar and Atlántico presented low TDP, with an average of less than 3.1%.

Regarding *Brucella* positivity in bovine population (BPos), from 2005 to 2013 the CAA held 47% of the 215,006 animals that were positive in the country; This was considerably influenced by the departments of Antioquia (39,227) and Córdoba (25,517), whose BPos MDA (4,359 and 2,835, respectively) was above the country (741) and regional (1,402) average.

The BExa MDA for the country was 17,030 and in the CAA it was 33,860. The departments of Antioquia, Córdoba and Cesar greatly exceeded these values. In relation to the TDB, the MDA in the country was 2.7% and in the CAA it represented 2.5%, where Antioquia, Córdoba and Cesar again, stood out for their greater epidemiological surveillance in the animal population; Conversely, the departments of Bolívar, Guajira and Magdalena had the lowest surveillance, with an average of less than 1.6%.

The TPosB for the departments of the CAA (5.8%, CI95%: 3.72-7.82) was statistically the same ($t=0.46833$, $gl=71$, $p=0.641$) to the country average (5.3%); However, the department of Magdalena presented a considerably high rate (13.8%).

Temporal analysis of the diagnostic coverage (PExa) and the positivity of farms (PPos) and bovines (BPos) to *Brucella* during the period between 2005 and 2013 is shown in figures 2 and 3.

Regarding the farms (Figure 2), in Colombia and the CAA, a continuous increase in farm surveillance (PExa) and in the number of positive establishments (PPos) was observed until 2012; However, TPosP remained high with an MDA of 24.8% in Colombia and 27.9% in the CAA. In the years of 2010 and 2011 there was no increase in PExa in the CAA. The largest land coverage was in 2012 and the lowest was in 2013. Until 2012, the departments of Antioquia, Córdoba and Sucre showed a better trend in the continuity of the diagnostic coverage; Conversely, Cesar, Magdalena, Bolívar, Guajira and Atlántico presented lack of stability or decrease in the number of diagnoses, however, TPosP continued to be a relevant problem.

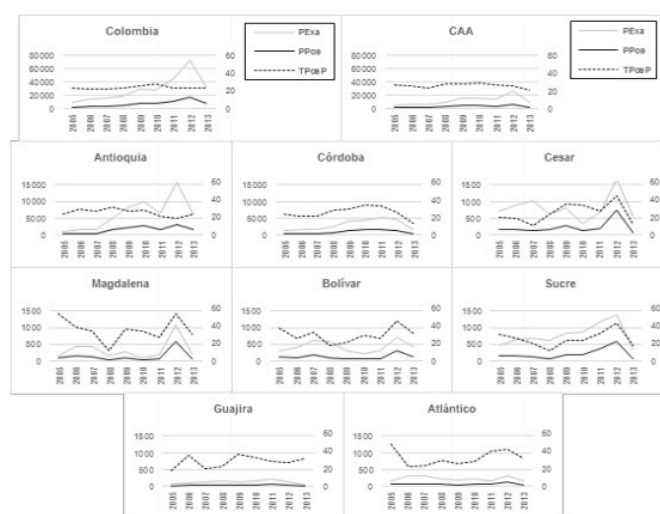


Figure 2. Diagnostic coverage (PExa) and positivity (PPos and TPosP) to brucellosis in livestock farms in Colombia and the CAA region, during the period 2005 - 2013. TPosP is assessed on the right axis.

Regarding cattle (Figure 3), the temporal analysis of the number of diagnoses (BExa) showed a tendency to increase until 2012 in Colombia and in the CAA region. This trend was affected during the years 2010 and 2011. Conversely, TPosB decreased until 2009, and increased in 2010 and 2011; Then, it again, showed a decreasing trend. However, in 2013 there was another sharp fall in epidemiological surveillance. Regarding the departments, Antioquia and Córdoba presented the best diagnostic coverage. In turn, Magdalena, Bolívar, Sucre and Atlántico presented, for many years, the highest TPosB. The results showed a direct and positive association between the number of diagnoses and the positivity to brucellosis at farm and cattle levels.

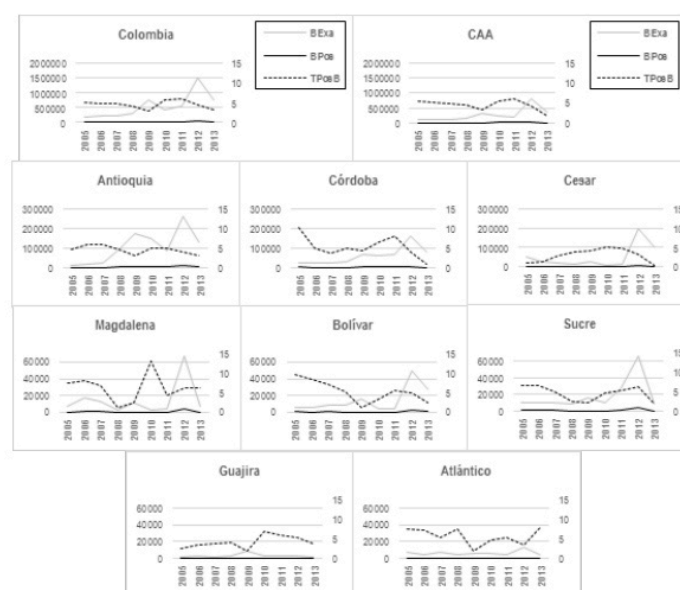


Figure 3. Diagnostic coverage (BExa) and positivity (BPos and TPosB) of brucellosis in the bovine population of Colombia and the CAA region, during the period 2005 - 2013. The TPosB is evaluated in the right axis.

DISCUSSION

he number of diagnoses, cases, and the rate of positivity are basic parameters that should be considered in an integrated way, in epidemiological surveillance of infectious diseases (11,12,13,14,15). An ideal condition in epidemiological surveillance is the continuity or constant increase in the number of diagnoses and the decrease or proximity to 0 in the positivity rate; The comprehensiveness of these conditions indicates improvement in the control, prevention and eradication of infe

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Under the above considerations, it can be stated that between 2005 and 2009 the best stage of the National Program for Prevention, Control and Eradication of Bovine Brucellosis in Colombia took place, especially in the CAA region. During this time, there was a tendency for a continuous increase in the number of animals diagnosed with a constant reduction in the positivity rate. In Colombia, the TPosB increased from 5.22% to 2.80%, which increased in the CAA from 5.39% to 3.21%. On the other hand, the TPosP remained relatively stable for the country and the region.

The worst years for the bovine brucellosis program were 2010 and 2011. During 2011 the TPosB in Colombia and in the CAA exceeded 6%. On the other hand, in 2012 and 2013 there was an improvement in the program indicators. In 2013 TPosB was 3.26% for Colombia and 1.85% for the CAA. The low TPosB in 2013 was possibly a consequence of the effective monitoring carried out in 2012, which according to legal regulations (3, 17) identified and sacrificed 34,429 positive animals in the CAA.

Overall, the epidemiological surveillance carried out by the National Program for Prevention, Control and Eradication of Bovine Brucellosis in the CAA during the period of 2005 to 2013, showed remarkable results, as stated by Tique et al (9) in studies In the department of Cordoba. The best results were observed in the departments with the highest bovine population: Antioquia, Córdoba and Cesar. Unfortunately, although the department of Cesar presented the lowest TPosB in 2005 (1.02%), it neglected the continuity of the

national program, allowing a continuous increase to reach 4.9% in 2011. Again in 2013 the TPosB was close to that of 2005.

On the other hand, in 2013, Atlántico and Magdalena presented the highest TPosB, with values of 7.7% and 6.1%, respectively. In relation to the TPosP, only the departments of Antioquia and Córdoba presented a favorable historical decreasing trend, in the other departments during the period of study, very high rates of positivity prevailed. In 2012, Cesar, Magdalena, Bolívar, Sucre and Atlántico presented TPosP above 40%, while Guajira approached this value in 2013.

The effectiveness of surveillance can be inferred by the rates of diagnoses in farms (TDP) and cattle (TDB), these rates express the relative representativeness of brucellosis sampling in each department. During the study period, the year 2012 was the one that showed the greatest historical sampling representativeness in all departments. However, the best numbers were observed in the departments with the highest bovine population.

The instability or reduction in the number of PExa in many departments is a situation that shows less effectiveness in the monitoring of the program of control of bovine brucellosis in the CAA. This is demonstrated by the low number of herds declared free of brucellosis in the departments of the Coast, and the non-existence of certified free aras. In December of 2015, 20,932 bovine brucellosis-free farms had been certified in Colombia, 4,174 were in the department of Antioquia and only 196 in the Atlantic Coast; 17 in Atlántico, 17 in Bolívar, 38 in Cesar, 85 in Córdoba, 9 in La Guajira, 7 in Magdalena and 23 in Sucre.

Although Antioquia, Córdoba and Cesar presented the best epidemiological indicators within the bovine brucellosis control program, it is necessary to address the status of the disease in its different municipalities. The analysis of the local situation within each department will allow a better diagnosis of the epidemiological situation of brucellosis and a greater effectiveness for the strategic intervention and obtaining results.

To conclude, during the period between 2005 and 2013, the National Program for the Prevention, Control and Eradication of Bovine Brucellosis in the Atlantic Coast and Antioquia presented promising results. However, the lack of continuity in diagnostic surveillance during certain years has adversely affected its progress. The results of the positive rates during 2013 are encouraging. However, the extreme reduction in the number of diagnoses in this same year could compromise in the results achieved in the following years, which is similar to what was observed in 2010 and 2011. The rate of positivity of bovine brucellosis at farm level continues to be high. Therefore, more government policies upon the producer guild is required, especially in the strengthening of the requirements for declared free herds. The program has been most effective in the departments with the largest bovine population. Therefore, strategies aimed at improving indicators should be proposed in the departments that most affected the epidemiological indicators in the region.

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