https://doi.org/10.22319/rmcp.v11i3.5154

Article

Seroprevalence of viral agents of the Bovine Respiratory Complex in Creole breeds of the Turipaná Research Center of AGROSAVIA

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Abstract:

A descriptive cross-sectional study was conducted in order to determine the prevalence and epidemiological factors associated with viral diseases of the Bovine Respiratory Complex (BRC) in Creole breeds of the Turipaná Research Center - AGROSAVIA (Colombia). A total of 403 cattle of the Romosinuano breed and 445 of Horned Coastal Creole cattle (CCC, Spanish acronym) breeds were evaluated. The presence of antibodies for bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) was determined through the indirect ELISA technique. The prevalences were estimated, and the associations between the viral agents and the variables of sex, age, herd type and breed were evaluated. The Chi-square test was applied with a level of 5% significance and the effect of the association was determined by the Odds

Ratio (OR). A logistic regression model was constructed to explain the most prevalent disease. The mean prevalences in both breeds were: BVD (33.02 %), BRSV (18.51 %), IBR (12.85 %) and PI3 (11.20 %); however, individually, the CCC breed had a higher prevalence for all diseases. The regression model showed an association between DVB, IBR and PI3, sex, age, females of more than 1 year of age, and the CCC breed. In order to address the diseases of the BRC, it is recommend actions with an emphasis on the control and prevention of BVD and deeper studies to understand the dynamics and co-endemicity of the BVD, IBR, BRSV and PI3 in the breeds studied.

Key words: Seroprevalence, Bovine respiratory complex, Bovine respiratory disease, Romosinuano, Horned Coastal Creole.

Received: 20/11/2018

Accepted: 23/09/2019

Introduction

Bovine respiratory complex (BRC) diseases are one of the main causes of economic losses in livestock farms[1]. These losses are ascribed to decreased production efficiency, treatment costs, increased labor and death of animals due to pneumonia[2]. The development of BRC is associated with environmental factors (management, stress and feeding), individual-specific factors (age, body condition and immunity), and the action of infectious agents (viruses, bacteria, and parasites)[1]. Viral agents associated with BRC diseases include the IBR, PI3, BRSV and BVD viruses[3].

Respiratory disease occurs when a pathogenic virus infects the host and allows opportunistic bacteria, normally present in the upper respiratory tract, to invade the lungs and cause severe pneumonia and death. These bacteria include *Pasteurella multocida*, *Mannheimia haemolytica*, *Mycoplasma bovis*, and *Histophilus somni*[1].

Epidemiological studies in the municipality of Montería, department of Córdoba, Colombia, determined the seroprevalence of viruses associated with BRC, the percentages being 74.7 % for IBR[4], 29.4 % for BVD[5], 13.5 % for PI-3[6], and 13 % for BRSV[7].

The aim of this study was to analyze the presence of the BVD, IBR, PI3, and BRSV viruses involved in the BRC diseases and the associated epidemiological factors in the two Creole bovine breeds at the Turipaná Research Center of AGROSAVIA, in the municipality of Cereté, Córdoba.

Material and methods

Study site

The study was conducted at the research center, located at 8°50'79" N and -75°47'58" W, in the municipality of Cereté, department of Córdoba, Colombia. The area is classified as dry tropical forest; it is located an altitude of 14 m asl, and has an average temperature of 27.5 ºC, a relative humidity of 81 %, and an average annual precipitation of 1,340 mm, 85 % of which falls between the months of April and November[8].

Type of study and sample size

A cross-sectional descriptive epidemiological study was conducted on all animals of the two Creole breeds, Romosinuano (403 animals) and Horned Coastal Creole (CCC), 445 animals, at the Turipaná research center in AGROSAVIA. The study was conducted from May to October, 2016.

Sample processing

After disinfection of the area, 5 ml of blood was collected from the coccygeal vein, in Vacutainer® tubes without anticoagulant. Samples were marked with the animal number and date of collection and stored at 4ºC. They were then centrifuged at 3,500 rpm during 5 min in order to obtain serum, and subsequently placed in vials and stored at -20 ºC until further analysis. They were processed in the laboratory at the Tibaitatá research center of AGROSAVIA, in the department of Cundinamarca, using commercial ELISA test kits (Synbiotics® for BVD and IBR, Biox Prionics® for BRSV and PI3), following the manufacturers' recommendations.

Data analysis

The prevalence study was accompanied by an epidemiological survey aimed at determining factors that may be associated with the pathologies under study —such as sex, breed (Romosinuano and CCC), age (<1 year and >1 year), and herd type (Germplasm Bank and Genetic Improvement)— were analyzed. These factors were associated in a univariate way with the (positive or negative) serological results of each one of the studied infectious agents; the Chi-square statistic and a significance level of 0.05 were applied; additionally, probability ratio measures were determined. Finally, a logistic regression model was constructed to explain the correlation between the factors and diseases studied; as a response variable, the disease with the highest prevalence was selected. Data were analyzed using the EpiInfo 7.2.1.0® software.

Results and discussion

The BVD, IBR, PI3 and BRSV viruses, which are part of the BRC complex, have been reported in different cattle farms in Colombia. However, this study is the first one that seeks to determine their prevalence in the Romosinuano and CCC creole breeds. These breeds are claimed to be resistant and well adapted to the ecological conditions of the low tropics on the northern coast of Colombia[9,10]. However, both exhibited seroprevalence for the four viral diseases of the BRC, with CCC being the most susceptible (Table 1). The virus with the greatest presence in both races was the BVD virus, with a prevalence rate of 33.60 %, followed by the BRSV, with almost half the percentage (18.51 %), while the agents with the least presence were IBR and PI3, with prevalence rates of 12.8 % and 11.20 %, respectively.

Table 1: Seroprevalence of BRC viral diseases in the races of the Turipaná Research Center (%)

Disease	Variables	Categories	n+	n-	Seroprevalence
DVB	Breed	Romosinuano	100	303	24.81
		CCC	185	265	40.45
BRSV	Breed	Romosinuano	60	343	14.89
		CCC	97	348	21.80
IBR	Breed	Romosinuano	47	356	11.66
		CCC	62	383	13.93
PI3	Breed	Romosinuano	29	374	7.20
		CCC	66	379	14.83

As in this study, a high seroprevalence for BVD has been confirmed in other regions of Colombia; a previous study in the municipality of Montería reported 29.5 % seropositivity[6], and another study carried out in the department of Cesar obtained results of 46 %[11].

BRSV is believed to be prevalent in cattle populations worldwide. Studies on this virus in animals with a history of infertility in Montería yielded seroprevalences of 13 %[5], and of 31 % in newborn calves[12]. In England, 83 % of cattle have antibodies, and in the United States, this is implicated in more than 50 % or respiratory diseases among fattening cattle[13].

The prevalence of IBR in cattle has been reported historically in several regions of Colombia. In 1982, seropositivity was found to be 51.7 % in the Caribbean region; 21.5%, in the Andean region, and 20.6% in the Pie de Monte Llanero region[14]. Recently, prevalences of 55.5% were reported in the Magdalena region[15], and of 35.65 % in the municipality of Toca - Boyacá[16]. Among the reports analyzed[17], the highest seroprevalences for this virus have been reported in the municipality of Montería, where the seroprevalence in females with a history of infertility was 74.7 %[4], and 60 % in newborn calves[12]; in the department of Antioquia, a prevalence of 68.9 %[18] was reported in the Creole White Black-eared breed. Seroprevalences of 44.6 % were found in Argentina[2] and 81.8 % in Peru[19].

Tables 2, 3, 4 and 5 show the univariate analysis of the factors studied on the different BRC diseases. The greater susceptibility of females to BRC diseases could be explained as a consequence of the high number of handlings carried out on females, due to a greater productive and reproductive demand. Factors associated with milking, artificial insemination and embryo transfer are considered to be stress factors that may render the females more susceptible to disease than the males[20].

Table 2: Univariate analysis of factors associated with BVDV in the Creole cattle herd at the Turipaná Research Centre in Corpoica

Variables	Categories	n+	n-	*P*-value	O.R.	95% CI	
						Lower	Higher
Sex	Male	41	232	<0.001	4.025	2.776	5.833
	Female	239	336				
Age	< 1 year	47	185	<0.001	2.395	1.672	3.430
	> 1 year	233	383				
Herd	Genetic Improvement	11	71	<0.001	3.493	1.819	6.706
	Germplasm Bank	269	497				
Breed	Romosinuano	100	303	<0.001	2.058	1.532	2.763

Table 3: Univariate analysis of factors associated with IBR virus in the Creole cattle herd of the Turipaná Research Center of AGROSAVIA

Variables	Categories	n+	n-	*P*-value	O.R.	95% CI	
						Lower	Higher
Sex	Male	26	247	0.045	1.602	1.005	2.554
	Female	83	492				
Age	< 1 year	37	195	0.098	0.698	0.454	1.071
	> 1 year	72	544				
Herd	Genetic Improvement	11	71	0.873	0.946	0.484	1.849
	Germplasm Bank	98	668				
Breed	Romosinuano	47	356	0.324	1.226	0.817	1.839
	CCC	62	383				

Table 4: Univariate analysis of factors associated with the VHL in the Creole cattle herd of the Turipaná Research Center of Corpoica

Variables	Categories	n+	n-	*P*-value	O.R.	95% CI	
						Lower	Higher
Sex	Male	36	237	0.005	1.754	1.171	2.627
	Female	121	454				
Age	< 1 year	50	182	0.162	0.765	0.525	1.115
	> 1 year	107	509				
Herd	Genetic Improvement	19	63	0.253	0.728	0.422	1.256
	Germplasm Bank	138	628				
Breed	Romosinuano	60	343	0.009	1.593	1.117	2.272
	CCC	97	348				

Table 5: Univariate analysis of factors associated with the PI3 virus in the Creole cattle herd at the Turipaná Research Center in Corpoica

Variables	Categories	n+	n-	*P*-value	O.R.	95% CI	
						Lower	Higher
Sex	Male	9	264	<0.001	5.158	2.554	10.417
	Female	86	489				
Age	< 1 year	10	222	0.000	3.554	1.812	6.971
	> 1 year	85	531				
Herd	Genetic Improvement	1	81	0.002	11.330	1.558	8.237
	Germplasm Bank	94	672				
Breed	Romosinuano	29	374	<0.001	2.245	1.418	3.555
	CCC	66	379				

Age was positively associated with BVD and PI3, with animals aged >1 year being most affected (2.39 and 3.55 times, respectively). Although cattle are susceptible to BVD infection at all ages, animals older than one year are more likely to be seropositive. This is probably

due to decreased passive immunity resulting from maternal antibodies and from a longer exposure time to the pathogens involved in the disease[21].

The herd type was also associated with BVD and PI3. In this sense, the Germplasm Bank herd was more affected than that of the breeding program (3.49 and 11.33 times for BVD and PI3, respectively). The higher susceptibility of the cattle in the Germplasm Bank may be accounted for by the higher population density in this group, which favors the aerogenic dispersion of these viruses; the higher humidity in the pastures used by these animals is another factor that favors the occurrence of the disease[22].

The univariate analysis showed a statistical association between the race variable and BVD, RSV and PI3 viruses, with CCC being the most seropositive to these three infectious agents, compared to the Romosinuano breed. The CCC was 2.05 times more seropositive for BVD, 1.59 times more seropositive for BRSV, and 2.24 times more seropositive for PI3. However, multivariate analysis only revealed a statistically significant association between CCC and BVD (OR= 1.845, 95 % CI = 1.349-2.523, $P<0.001$). There are no studies that demonstrate that the CCC breed has a higher exposure to these infectious agents than Romosinuano. Therefore, this study suggests conducting specific immunological studies in order to further research breed-specific susceptibility to these diseases.

BVD and PI3 viruses were the only infectious agents that presented a statistical association with all the variables studied. However, since BVD was more frequent in the studied herds, the logistic regression model for viral diseases of the BRD complex was based on BVD.

The logistic regression model (Table 6) showed that BVD has an association with female sex, animals aged over one year, and the CCC breed, suggesting that these factors may significantly contribute to the development of these infections. The association between BVD, IBR and PI3 was also demonstrated. IBR-positive animals are 3.04 times more likely to have BVD, while PI3-positive animals are 3.81 times more likely. However, given the type of serological diagnosis and because this is a cross-sectional study, it is not possible to detect a causal relationship between the three diseases or to evaluate a time sequence in their occurrence. Although the final model showed epidemiological relevance, the log-likelihood and Hosmer-Lemeshow statistics indicated a poor model fit. Nevertheless, variable elimination was not considered because all the variables left in the final model have epidemiological significance, as confirmed by the univariate statistics. Further epidemiological studies on these issues are required.

Table 6: Logistic regression model for BRC diseases, based on the BVD virus

Variables	Categories	*P*-value	O.R.	95% CI	
				Lower	Higher
Sex	Male	<0.001	3.833	2.587	5.678
	Female				
Age	< 1 year	<0.002	1.871	1.262	2.773
	> 1 year				
Breed	Romosinuano	<0.001	2.564	1.846	3.561
	CCC				
IBR	Negative	<0.001	3.045	1.659	5.589
	Positive				
PI3	Negative	<0.001	3.811	1.966	7.386
	Positive				

Conclusions and implications

In conclusion, all the main viral agents involved in the BRD complex are present in the Creole livestock of the Turipaná Research Center. An action plan is recommended to control and prevent these diseases at the research center, with an emphasis on the control and prevention of BVD. In addition, further follow-up studies are required in order to understand the dynamics and co-endemicity processes of the BVD, IBR, BRSV and PI3 viruses in the Romosinuano and CCC breeds.

Acknowledgements

The authors would like to thank the National System of Germplasm Banks for Food and Agriculture (Sistema de Bancos de Germoplasma de la Nación para la Alimentación y la Agricultura, SBGNAA), based at the Turipaná Research Center of AGROSAVIA, for allowing access to the cattle used in this research.

Conflict of interests

The authors declare that they have no conflict of interests.

Literature cited:

1. Gershwin LJ, Van Eenennaam AL, Anderson ML, McEligot HA, Shao MX, Toaff-Rosenstein R *et al*. Single Pathogen Challenge with Agents of the Bovine Respiratory Disease Complex. PLoS One 2015; 10(11):142-479. https://doi.org/10.1371/journal.pone.0142479.

2. Carbonero A, Maldonado A, Perea A, García-Bocanegra I, Borge C, Torralbo A *et al*. Factores de riesgo del síndrome respiratorio bovino en terneros lactantes de Argentina. Arch Zoot 2011; 60 (229):41-51. https://dx.doi.org/10.4321/S0004-05922011000100005.

3. Grissett GP, White BJ, Larson RL. Structured literature review of responses of cattle to viral and bacterial pathogens causing bovine respiratory disease complex. J Vet Intern Med 2015;29(3):770-780. http://doi.org/10.1111/jvim.12597.

4. Betancur C, González M, Reza L. Seroepidemiología de la rinotraqueitis infecciosa bovina en el municipio de Montería, Colombia. Rev MVZ Córdoba 2006;11(2):830-836. https://doi.org/10.21897/rmvz.447.

5. Betancur H, Rodas J, González M. Estudio seroepidemiológico del virus respiratorio sincitial bovino en el municipio de Montería, Colombia. Rev MVZ Córdoba 2011;16(3):2778-2784. https://doi.org/10.21897/rmvz.278.

6. Betancur H, Gogorza LM, Martínez FG. Seroepidemiología de la diarrea viral bovina en Montería (Córdoba, Colombia). Analecta Vet 2007;27(2):11-16. http://sedici.unlp.edu.ar/handle/10915/11204.

7. Betancur H, Orrego A, González M. Estudio seroepidemiológico del virus de parainfluenza 3 en bovinos del municipio de Montería (Colombia) con trastornos reproductivos. Rev Mev Vet 2010;20: 63-70. https://doi.org/10.19052/mv.583.

8. Saraz GA. Influencia de los factores genéticos y ambientales en caracteres productivos y reproductivos de la raza criolla colombiana Romosinuano (No. Doc. 22372, CO-BAC, Bogotá). 2004.

9. Ossa G, Abuabara Y, García JP, Martínez G. El ganado criollo colombiano Costeño con Cuernos (CCC). Anim Genet Resour 2011;48:101-107.

10. Elzo MA, Manrique C, Ossa G, Acosta O. Additive and nonadditive genetic variability for growth traits in the Turipana Romosinuano × Zebu multibreed herd. J Anim Sci 1998;76:1539-1549. https://doi.org/10.2527/1998.7661539x.

11. Peña IF. Estudio serológico de diarrea viral bovina en la microrregión del valle del Cesar. AICA 2011; 1:309-312. Disponible en: https://aicarevista.jimdo.com/.

12. Betancur HC, Castañeda TJ, González TM. Inmunopatología del complejo respiratorio bovino en terneros neonatos en Montería-Colombia. Rev Cient 2017;27(2):95-102.

13. Tjørnehøj K, Uttenthal Å, Viuff B, Larsen LE, Røntved C, Rønsholt L. An experimental infection model for reproduction of calf pneumonia with bovine respiratory syncytial virus (BRSV) based on one combined exposure of calves. Res Vet Sci 2003;74(1):55-65. https://doi.org/10.1016/S0034-5288(02)00154-6.

14. Griffiths IB, Gallego M, Villamil L. Factores de infertilidad y pérdidas económicas en ganado de leche en Colombia (No. Doc. 4186)* CO-BAC, Santafé de Bogotá). 1982.

15. Piedrahita LE, Montoya LM, Pedraza FJ. Herpes Virus Bovino tipo 1 (BoHV-1) como posible causa de encefalitis en bovinos de la región del Magdalena Medio Colombiano: Estudio serológico y análisis epidemiológico. Rev Colom Cienc Pecu 2010;23(2):191-198.

16. Ochoa X, Orbegozo M, Manrique F, Pulido M, Ospina J. Seroprevalencia de rinotraqueitis infecciosa bovina en hatos lecheros de Toca – Boyacá. Rev MVZ Córdoba 2012;17(2):2974-2982.

17. Sobhy NM, Mor SK, Bastawecy IM, Fakhry HM, Youssef CRB, Goyal SM. Surveillance, isolation and complete genome sequence of bovine parainfluenza virus type 3 in Egyptian cattle. Int J Vet Sci Med 2017;5(1):8-13. doi: 10.1016/j.ijvsm.2017.02.004.

18. Molina SH, Castaño J, Arboleda J, Cadavid J, Zapata M. Estudio serológico para el virus de parainfluenza-3 en el hato BON en el departamento de Antioquia. Rev Colomb Cienc Pecu 1998;11(2):81-86.

19. Cabello R, Quispe Ch, Rivera G. Frecuencia de los virus Parainfluenza-3, Respiratorio Sincitial y Diarrea Viral Bovina en un rebaño mixto de una comunidad campesina de Cusco. RIVEP 2006;17(2):167-172. http://dx.doi.org/10.15381/rivep.v17i2.1535.

20. Chamizo EG. Leucosis bovina enzootica: Revisión. REDVET 2005;6(7):21-25. http//www.redalyc.org/articulo.oa?id=63612652016.

21. Ellis J, West K, Cortese V, Konoby C, Weigel D. Effect of maternal antibodies on induction and persistence of vaccine-induced immune responses against bovine viral diarrhea virus type II in young calves. J Am Vet Med Assoc 2001;219(3):351-356. https://doi.org/10.2460/javma.2001.219.351.

22. Morán P, Di Santo M, Gogorza L. Transmisión del virus de la diarrea viral bovina. Factores de riesgo en el ingreso y diseminación en los rodeos. Rev Vet 2006;17(1): 50-58.