

Management factors associated with bovine tuberculosis on dairy herds in Rio de Janeiro, Brazil

Fatores de manejo associados à ocorrência de tuberculose bovina em rebanhos leiteiros do Rio de Janeiro, Brasil

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Abstract

With the purpose of identifying management factors that may be influencing the prevalence of bovine tuberculosis under tropical conditions, namely in Rio de Janeiro, Brazil, 1632 cows were tested through the single cervical tuberculin test. A questionnaire was completed for each herd. A total of 207 positive reactions were observed, corresponding to 12.7% of the studied cattle. The main factors observed that may be influencing the prevalence of bovine tuberculosis on those farms were the absence or reduced veterinary assistance and the herd size. The presence of adequate cattle houses and the highly intensive management are also considered to be likely to influence the prevalence of the disease. Under tropical conditions, a tuberculosis control program, in addition to the test-and-slaughter control method, should include an investigation of herd management practices to try to identify factors that are likely to influence the prevalence of the disease.

Keywords: tuberculosis, bovine, epidemiology, *M. bovis*, Brazil.

Resumo

Com o objetivo de identificar fatores que possam influenciar a prevalência de tuberculose bovina em condições tropicais, em especial no Rio de Janeiro, Brasil, 1632 vacas foram testadas pelo teste intradérmico simples com tuberculina bovina. Um questionário foi completado para cada rebanho. Um total de 207 reações positivas foi observado, o que correspondeu a 12,7% do gado estudado. Os principais fatores observados que podem influenciar na prevalência de tuberculose bovina nestes rebanhos foram a ausência ou reduzida assistência veterinária e o tamanho do rebanho. A presença de estábulos adequados e o manejo intensivo também foram considerados como fatores que podem influenciar na prevalência da enfermidade. Em condições tropicais, um programa de controle da tuberculose deve, além do método de teste-e-abate, incluir uma investigação das práticas de manejo adotadas no rebanho a fim de tentar identificar fatores que possam influenciar na prevalência da enfermidade.

Palavras-chave: tuberculose, bovinos, epidemiologia, *M. bovis*, Brasil.

Introduction

Bovine tuberculosis is a disease of worldwide occurrence that causes great harm to dairy farms and health risks to the population that consumes products of animal origin. It is still a problem of both public health and economic importance in large areas of the world (Kantor & Ritacco, 1994). In Brazil, in spite of a governmental eradication program, it represents an important disease in various regions of the country (Lilenbaum et al., 1999; Leite et al., 2003).

In several countries badgers, cervids and other animals from wildlife represents important sources of *M. bovis* to cattle and act as reservoirs of the disease (Griffin et al., 1993, Kaneene et al., 2002). Nevertheless, in Rio de Janeiro there is no evidence that wildlife could be implicated as important

members of the disease transmission. Therefore, the main transmission via is the bovine-bovine route (Perumaalla et al., 1999) and the identification of management practices that can be associated to the spread of the disease may represent an important tool in order to facilitate the tuberculosis eradication on dairy farms.

Some of the factors that may influence the occurrence of bovine tuberculosis have already been described, as the management of colostrum and milk in dairy calves (Evangelista & De Anda, 1996), the location of the farm in an area with a high level of tuberculosis (O'Connor et al., 1993), the waste management and treatment of manure (Haheesy et al., 1992a) and the herd size and contiguity to other tuberculosis restricted herds (Griffin et al., 1996). In Ireland, farm management has been put forward as an explanation for recurrent breakdowns of the

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disease (Griffin et al., 1993). However, farming conditions may vary significantly from one to other country, what reflects on the prevalence of infectious diseases. Even when considering only the dairy herds from a restricted area, prevalence of the disease may vary considerably. Therefore, the question of why some dairy herds present low infection rates when tuberculosis (TB) heavily affects other herds located in the same regions is still unclear. The purpose of that study was to identify major farm management factors associated with bovine tuberculosis on dairy herds under tropical conditions, namely in Rio de Janeiro, Brazil.

Materials and methods

A total of 1632 adult cows originated from 13 dairy herds located around the city of Rio de Janeiro, Brazil were tested through intradermal tuberculin tests. All herds presented previous history of bovine tuberculosis, including animals with visible lesions at the slaughter. In order to compare data with tuberculosis-free herds, in a case-control study design, eight dairy herds with no history of bovine tuberculosis were also tested through intradermal tuberculin tests. Each herd comprised between 30 and 392 animals. Considering the average size of dairy herds in Rio de Janeiro, herds have been classified as large (>90 adult cows) or small (<90 adult cows).

All cows were tested through the single cervical tuberculin test (SCTT) with the injection of 0.1 ml of bovine PPD (*M. bovis* strain AN5, 1 mg protein/mL; Tecpar, Brazil), corresponding to 5000 IU per dose and examination of the site after 72 hours. The interpretation of the results was performed according to the recommendations of the Ministry of Agriculture in Brazil, i.e., a positive animal has more than 4.0 mm of swelling at the site of injection. The intradermal tuberculin test is the standard test for detection of bovine tuberculosis in Brazil, where a sensitivity of 88.3% has been demonstrated (Lilenbaum et al., 1999). The test is based on the detection of cell-mediated immunity (CMI) *in vivo* to bovine tuberculin (purified protein derivative - bovine PPD) prepared from a culture filtrate of a laboratory strain of *M.bovis*.

A 48-point questionnaire was completed for each herd. Questions were related to management and sanitary conditions, climate, location, housing and frequency of veterinary attendance. Information about animal factors such as breed, age and milk production was also collected.

Data was analysed using the statistics software package SPSS version 8.0 (Statistical Package for the Social Science, SPSS Inc., Chicago, 1998). As a first step bivariate analysis was used to test for simple associations between each independent variable. The *t*-test was used for continuous variables and the χ^2 -test was used for categorical variables. Identification of a TB-associated factor required confidence level of 95% ($p < 0.05$) as well as a biological plausible association between the factor and bovine tuberculosis on dairy herds. The variable was then selected for further analysis in a second step, a logistic regression (Frankena and Graat, 1997; Hosmer and Lemeshow, 1989; Lemeshow and Hosmer, 1984).

Results and discussion

A total of 207 positive reactions were observed, corresponding to 12.7% of the studied cattle. Rate of reactivity ranged from

3.4% to 53.3% among the 13 infected herds. This was not an unexpected finding, since those herds presented previous history of tuberculosis. Among the eight herds believed to be tuberculosis-free, no animal presented reactive reactions, what confirmed their status.

Location and climate did not alter the risk of the disease. Those findings are in disagreement with O'Connor et al. (1993), who concluded that the dominant factor contributing for the occurrence of reactor to the tuberculin test in Ireland was the location of the herd in an area with a high level of tuberculosis. Nevertheless, Haheisy et al. (1992b) and Rajram et al. (1996) did not consider location or climate as important risk factors associated to tuberculosis in bovines. Rajram et al. (1996) observed in India that main factors influencing the prevalence of the disease were the intrinsically factors, inherent to the management of the farm. We consider that, since epidemiological and sanitary conditions in Brazil are more likely to India than to Ireland, management practices seems to represent the source of major factors influencing the occurrence of tuberculosis under tropical conditions.

The most significant factor involved was the frequency of veterinary attendance (OR = 2.29; $p = 0.0287$). Herds under frequent veterinary assistance or visited at least once a month showed average reactivity rates of 10.2%, ranging from 3.4% to 16.6%. On the other hand, herds infrequently visited by a veterinarian showed average reactivity rates of 16.7, ranging from 6.0% to 53.3%. Those findings agree with Rajram et al. (1996) and showed that the presence of the veterinarian on the farm can improve sanitary conditions of the cattle, which will reduce the incidence of various infectious diseases, including tuberculosis. To obtain that result, therefore, the veterinarian shall visit the farm at least once a month.

Another important factor associated with the reactivity to tuberculosis was the herd size. In Rio de Janeiro, differently from the big farms of central Brazil, dairy cattle are maintained on small properties, with small herds. Therefore, considering the local characteristics, herds were classified as large when it had at least 90 adult cows. Statistics showed that a cow from a large herd has twice a probability of being reactive to tuberculosis than those from smaller herds (OR=2,00; $p = 0,0218$). This was not an unexpected finding since, as observed by Griffin et al. (1996), the probability of tuberculosis occurring in a herd increases as a function of increase in size. Herd size was also considered as an important factor associated with tuberculosis in Michigan (Kaneene et al, 2002), and a similar number of cattle per herd (from <25 to >100) was observed in that study.

Some other possible factor associated to the occurrence of bovine tuberculosis were the presence of adequate cattle houses and the highly intensive management, represented by constant housing and less than 6 hours a day for grazing. Although logistical regression analysis showed those aspects to be not significant, the χ^2 -test demonstrate a clear association ($p < 0.01$) between those characteristics and reactivity to tuberculin tests. Herds with highly intensive management have been identified on previous studies as higher risk for tuberculosis (Griffin et al., 1993). The main distinct risk factors associated with intensively managed herds were not yet identified in Ireland (Griffin et al., 1996). Nevertheless, in India, Rajaram et al. (1996) identified constant housing, over stocking

and zerograzing as risk factors to bovine tuberculosis. Those findings highly agrees with ours, and we believe, that at least under tropical conditions, the constant housing and the absence of a minimum period of grazing of 6 hours a day may be considered as an important risk factor associated with the intensive management system that may be influencing the prevalence of bovine tuberculosis.

An unexpected result was that the influence of nutritional factors; offering of mineral salt and hay or ensilage during the winter showed to be non-significant. Although nutritional factors

have been identified in Ireland as factors influencing the prevalence of bovine tuberculosis and other infectious diseases (Griffin et al., 1993), in the present study no significant difference was observed on the percentage of reactors on farms with and without food supplement.

The conclusions of the present study are that, under tropical conditions, a tuberculosis control program, in addition to the test-and-slaughter control method, should include an investigation of herd management practices to try to identify factors that are likely to influence the prevalence of the disease.

Table 1: Management factors associated with bovine tuberculosis on dairy herds in Rio de Janeiro, Brazil.

Herd	No. Cows	Reactives	(%)	Vet assistance	Cattle house	Grazing	Supplement
1	32	3	(9.4)	Sporadic	Yes	Yes	No
2	38	3	(7.9)	Sporadic	No	Yes	No
3	33	2	(6.0)	Sporadic	Yes	Yes	No
4	34	3	(8.8)	Sporadic	No	Yes	No
5	96	7	(7.3)	Monthly	Yes	Yes	Yes
6	37	5	(13.5)	Sporadic	No	Yes	No
7	262	19	(7.2)	Frequent	Yes	Yes	Yes
8	382	65	(16.6)	Monthly	Yes	No	No
9	320	57	(15.8)	Monthly	Yes	Yes	Yes
10	177	6	(3.4)	Frequent	Yes	Yes	No
11	30	16	(53.3)	Sporadic	Yes	No	No
12	99	14	(17.7)	Sporadic	Yes	No	Yes
13	92	7	(11.3)	Monthly	No	Yes	No

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References

EVANGELISTA, T.B.R., DE ANDA J.H. Tuberculosis in dairy calves: risk of *Mycobacterium* spp. exposure associated with management of colostrum and milk. *Preventive Veterinary Medicine*, v. 27, p. 23-27, 1996.

FRANKENA, K., GRAAT, E.A.M. Multivariate analysis: logistic regression. In: Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Wageningen, p. 135-179, 1997.

GRIFFIN, J.M., HAHESEY, T., LYNCH, K., SALMAN, M.D., MCCARTHY, J., HURLEY, T. The association of cattle husbandry practices, environmental factors and farmer characteristics with the occurrence of chronic bovine tuberculosis in dairy herds in the Republic of Ireland. *Preventive Veterinary Medicine*, v. 17, p. 145-160, 1993.

GRIFFIN, J.M., MARTIN, S.W., THOBURN, M.A., EVES, J.A., HAMMOND, R.F. A case- control study of the association of selected risk factors with the occurrence of bovine tuberculosis in the Republic of Ireland. *Preventive Veterinary Medicine*, v. 27, p. 217-219, 1996.

HAHESEY, T., SCANLON, M., CARTON, O.T., QUINN, P.J., LENEHAN, J.J. Cattle manure and the spread of bovine tuberculosis. *Irish Veterinary Journal*, v. 45, p. 122-123, 1992a.

HAHESEY, T., KELLEHER, D.L., DOHERTY, J. An investigation of a possible association between the occurrence of bovine tuberculosis and weather variables. *Irish Veterinary Journal*, v. 45, p. 127-128, 1992b.

HOSMER, D.W., LEMESHOW, S. Applied Logistic Regression, first ed. Wiley, New York, 307 p., 1989.

KANTOR, I.N., RITACCO, V. Bovine tuberculosis in Latin America and the Caribbean: current status, control and eradication programs. *Veterinary Microbiology*, v. 40, p. 5-14, 1994.

KANEENE, J.B., BRUNING-FANN, C.S., GRANGER, L.M., MILLER, R., PORTER-SPALDING, B.A. Environmental and farm management factors associated with tuberculosis on cattle farms in northeastern Michigan. *Journal of Veterinary Medical Association*, v. 221, p. 837-842, 2002.

LEMESHOW, S., HOSMER, D.W.J. Estimating odds ratios with categorically scaled covariates in multiple logistic regression analysis. *American Journal of Epidemiology*, v. 119, p. 147-151, 1984.

LILENBAUM, W.; SCHETTINI, J.C.; SOUZA, G.N.; RIBEIRO, E.R.; MOREIRA, E.C.; FONSECA, L.S. Comparison between a g-IFN assay and intradermal tuberculin test for the diagnosis of bovine tuberculosis in field trials in Brazil. *Journal of Veterinary Medicine, Series B*, v.46, p. 353-358, 1999.

O'CONNOR, R., CONWAY, A., MURPHY, M. Study of Socio-Economic Impediments to Bovine Tuberculosis Eradication. A report by The Economic and Social Research Institute for the Eradication of Animal Disease Board. Dublin, 215 p., 1993.

PERUMAALLAA, V.S., ADAMSA, L.G., PAYEURB, J., BACAC, D., FICHTA T.A. Molecular fingerprinting confirms extensive cow-to-cow intra-herd transmission of a single *Mycobacterium bovis* strain. *Veterinary Microbiology*, v. 70, p. 269-276, 1999.

LEITE, CQF; ANNO, IS; LEITE, SRA; ROXO, E.; MORLOCK, GP; COOKSEY, RC. Isolation and identification of mycobacteria from livestock specimens and milk obtained in Brazil. *Memorias Instituto Oswaldo Cruz*, v.98, p. 319-323, 2003.

RAJARAM, E.D., APPJI RAO, V.N., MANICKAM, R. Certain epizootiological features of bovine tuberculosis. *Indian Veterinary Journal*, v. 73, p. 435-438, 1996.

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCE, version 8.0 SPSS Inc., Chicago, 1998.