Detection of Mycobacterium spp. in slaughter cattle at Gauteng abattoirs

01/01/2021

Prevalence and characterization of Mycobacterium spp. in slaughter cattle at Gauteng abattoirs: Food safety implications for meat consumers-A pilot study

Industry Sector: Cattle and Small Stock

Research Focus Area: Animal Health and Welfare

Year of completion: 2020

Primary Researcher: Dr Tiny Hlokwe

Secondary Researcher: Mrs V Mareledwane

The Research Team

Title	Name	Surname	Highest Qualification	Research Institution
Prof	AA	Adesiyun	PhD	University of Pretoria
Prof	P	Thompson	PhD	University of Pretoria

EXECUTIVE SUMMARY

Introduction

Tuberculosis is a disease that is caused by a group of acid-fast gram-positive bacteria belonging to the *Mycobacterium tuberculosis* complex. Tuberculosis has a wide species range but not all species are equally susceptible and are divided into maintenance hosts and spillover hosts. *M. tuberculosis* is mostly the causative agent in humans while *M. bovis* is the predominant causative agent of tuberculosis in animals. In animals, cattle and buffaloes are the reservoirs of the disease in South Africa. TB is a zoonotic disease with great economic impact estimated to billions of dollars annually. This is because, for many farmers, cattle are a source of income. The impact is greatly felt in productivity. The zoonotic potential of the disease is a very big concern to public health. In addition, the interference of non-tuberculous mycobacteria in the diagnosis of BTB cannot be underestimated.

Globally, abattoirs are used for passive and active surveillance of diseases of both economic and public health significance such as tuberculosis. Surveys by serological and bacterial culture assays of slaughter animals may be used to detect newly introduced disease agents and in monitoring disease control and eradication programmes. Information generated from abattoir surveillance could provide an early warning system for impending epidemics or failures of intervention programmes such as vaccination of livestock against certain diseases, thereby allowing early intervention efforts to prevent epidemic loss of animals. Losses may result from mortality in animal population, cost of quarantine, isolation and treatment and in

some cases loss of international trade. The usefulness of data obtained from abattoirs during surveillance for selected diseases is however dependent on the accuracy of the data obtained, data analysis and interpretation. Data generated from abattoirs could also be used to measure the potential health risk to farm workers, veterinarians or veterinary assistants attending to such animals, abattoir workers and consumers of products from the live animals, such as milk. The risk of zoonotic diseases, such as tuberculosis to workers who are exposed to infected animals pre-, during and post-slaughter, cannot be over-emphasized. Abattoirs in any country, if properly managed, are invaluable facilities for ensuring that only safe meat reaches the consumers, as well as preventing or reducing the potential health risk posed by infected or diseased animals to workers at these facilities.

Developed countries usually run efficient abattoirs and slaughterhouses and have effectively used them in the surveillance of diseases like tuberculosis and brucellosis in the USA, leptospirosis in New Zealand, and cystic echinococcosis in Spain. Reliable data obtained from abattoirs and slaughterhouses are used pro-actively to drive, monitor, change or formulate policies. In South Africa slaughterhouses are registered by government and closely inspected and audited for hygienic slaughter practices. Use of data obtained from these abattoirs for surveillance and diseases control purposes is however limited. The same applies to most other developing countries where, in most cases, slaughter practices in the abattoirs are not closely monitored by government and livestock diseases data are not captured and adequately used for surveillance and disease control.

In South Africa, as in most developing countries, there are also a number of unregistered informal slaughterhouses and small butcheries where virtually no hygiene monitoring, meat inspection or record keeping take place, thus creating a potential health risk to consumers. Records on zoonotic disease including Tuberculosis may be available at some abattoirs or laboratories country-wide, and these need to be accessed and analysed by researchers or veterinary officials as part of disease surveillance. This useful information may also be used for policy formulation on disease control. Furthermore, although some published reports exist on the detection of tuberculosis in livestock and wildlife diseases, the prevalence of the infections is largely unknown, particularly in communal livestock.

Objective Statements

The current study was conducted at selected abattoirs in the Gauteng province, South Africa and the main objective was to determine the prevalence of livestock TB in slaughter livestock in these abattoirs using a cell mediated immune assay (IFN-γ) and culture-based methods.

Project Aims

- To isolate and identify Mycobacterium spp. from granulomatous/tuberculous lesions, lymph nodes (i.e. mesenteric, supra-mammary, retropharyngeal and internal iliac) and lungs of slaughter cattle.
- To determine the prevalence of bovine tuberculosis in slaughter cattle in selected abattoirs (high throughput, low throughput and rural/informal by using cell-mediated immune assays.
- To characterize the isolates of Mycobacterium spp. recovered from cattle regarding their species identification and genotypes.
- To obtain demographic information on farm management (feedlot, cow-calf or communal); animal information (age: adult or young, sex: male or female; and breed)

by linking abattoir data back to the farms of origin and to visit farms from which seropositive animals originated to assess the existing risk factors for infection.

Results

A total of 410 fresh blood samples were collected from slaughter livestock (369 cattle and 41 sheep) from 15 abattoirs, and analysed using Bovigam® test kit.

Of the 369 cattle sampled, valid IFN-γ results (i.e. test samples passed quality control checks) were obtained in 318 (86.2%) of the cattle. The estimated prevalence of cattle positive for bTB was 4.4% (95% CI: 2.4-7.3%) (Table 1). Of the eight variables analysed, seven (animal species, sex, breed, district, municipalities, origin of animals and abattoir throughput) were not associated with the estimated prevalence of bTB. However, prevalence varied significantly between abattoirs (p=0.005), ranging between 3.6% (95% CI: 0.09-18.3%) in abattoir I to 23.1% (95% CI: 8.9%-43.6%) in abattoir B. The estimated prevalence of avian reactors was 5.9% (95% CI: 3.6-9.2%) (Table 2), also varying significantly between abattoirs (p=0.004), ranging from 3.6% (95% Cl: 0.09-18.3%) in abattoirs E and I to 20.7% (95% CI: 7.9-39.7%) in abattoir J. The prevalence of avian reactors in cattle was not significantly different to that of bTB. The estimated prevalence of cattle tested reacting to Mycobacterium spp. (combined bTB and avian reactors) was 10% (95% CI: 7.0-14%) (Table 3). In the univariate analysis, prevalence varied by sex of animal (3.0% in females and 11.9% in males) and by breed (5.4% in Jersey, 13% in Bonsmara, 0% in other breeds), but these differences were not significant after adjusting for confounding using exact logistic regression. Of the 41 sheep sampled, valid IFN-γ results were obtained in 22 (54%) of the animals and none were positive for bTB nor were there any avian reactors (95% CI: 0-15%) (Table 1-3). No isolation was made from all the tissue samples cultured. However, non-tuberculous mycobacteria were isolated from the environmental samples collected as confirmed by 16S rRNA gene analysis (see fig 1).

Conclusion

Meat inspection is a long-standing form of disease surveillance for both food safety and animal health. For diseases that produce slowly progressive but evident lesions, such as bTB, slaughterhouse inspection is an effective surveillance tool. The detection of positive bTB reactors in our study has, however, clearly illustrated the limitations of this method of disease surveillance, as the study also established that the abattoir source of the animals sampled significantly (p=0.005) affected the prevalence of bTB. The potential zoonotic risk of transmission to abattoir workers as well as food safety hazard to consumers, can therefore not be over-emphasized. Our study highlights the potential for the use of the IFN-γ assay in reducing this risk. Studies have demonstrated that the use IFN-γ assay in combination with other TB tests leads to a more accurate screening of bTB in cattle. Follow-up studies, with the intervention of the relevant area State Veterinarians, should be conducted to include using the animal information from the abattoir to trace back to the herds of origin and further testing of the whole herds.

Our study highlighted the inadequacy of meat inspection alone to detect bTB in cattle slaughtered for human consumption. It is therefore imperative to apply additional methods, such as the gamma interferon assay, to accurately determine the TB infection status in slaughter cattle from abattoirs. This approach will provide a true assessment of the risk of TB posed to abattoir workers and consumers of meat from infected cattle. Although we could not detect any Mycobacterium species by culture-based method, we are not surprised by these outcomes, as all slaughtered livestock were cleared of having suspect lesions.

Popular Article

Title for Popular Article

Inadequacy of Meat Inspection in the Surveillance of Bovine Tuberculosis: A Zoonotic and Food Safety Risk Concern

Background

Bovine tuberculosis (bTB) is a zoonotic disease with serious consequences for the livestock and wildlife industries around the world. The causative agent, normally *Mycobacterium bovis* (*M. bovis*), has a broad host range (domestic and wild animals). Meat inspection represents a long-standing form of disease surveillance that serves both food safety and animal health.

Occurrence of bovine tuberculosis in cattle

Although test and slaughter programme reduced the prevalence in commercial cattle in South Africa, disease outbreaks in different regions of the country still occur. Bovine tuberculosis is a zoonotic disease with great economic impact estimated to be billions of dollars annually. This is because, for many farmers, cattle are a source of income. The impact is greatly felt in productivity.

Bovine tuberculosis as a zoonosis

Mycobacterium bovis is known to cause tuberculosis in both animals and humans, which makes this bacterium a potentially important zoonotic species. People are most commonly infected with *M. bovis* by drinking or eating contaminated and unpasteurised milk and milk products. Infection can also occur through direct contact with a wound of an infected animal during slaughter.

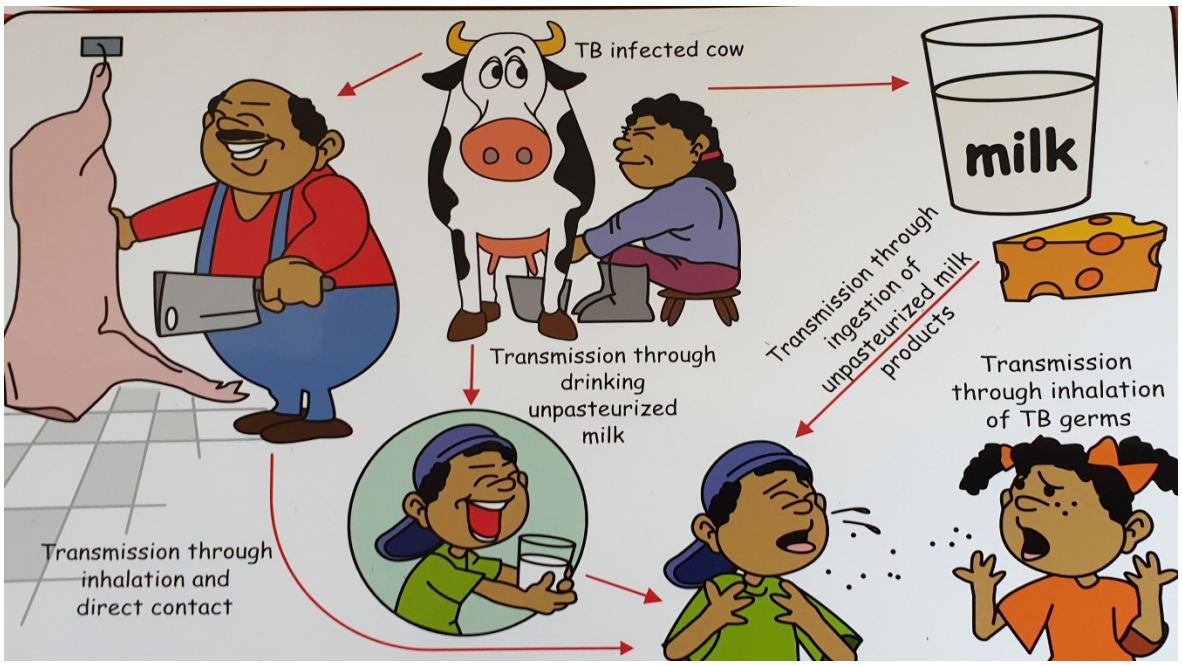

Figure 1 shows different ways by which bovine tuberculosis can be transmitted from cattle to people

Use of abattoirs in the surveillance of bovine tuberculosis

Globally, abattoirs are used for passive and active surveillance of diseases, such as bTB, of both economic and public health significance. Our team, consisting of researchers from the University of Pretoria and Onderstepoort Veterinary Research recently conducted a study to investigate the prevalence of bTB in slaughter livestock at 15 abattoirs in Gauteng, South Africa. A total of 410 fresh blood samples were collected from slaughter livestock (369 cattle and 41 sheep) and analysed using Bovigam® test kit.

Outcome and implications

The estimated prevalence of the disease in cattle was 4.4% (95% CI: 2.4-7.3%), and varied among abattoirs, ranging from 0 to 23%; however, there were no significant differences among genders, breeds, municipalities, districts, origin of animal (feedlot, auction or farm) or throughput of abattoirs. None of the sheep sampled was positive for the disease. Results obtained clearly illustrated the limitation of disease surveillance using a meat inspection approach alone, considering that all the 410 slaughter animals sampled had passed visual abattoir inspection and therefore classified as free of bTB.

Zoonotic risk and food safety implications for meat consumers

Our findings therefore emphasize the zoonotic risk of transmission of bTB to abattoir workers and a potential food safety hazard to consumers. Furthermore, our study highlights the potential to use of the blood assay (Bovigam® test kit) for bTB surveillance at abattoirs.

Research Funding

The research was made possible through funds kindly provided by the Red Meat Research and Development (RMRD)-SA and the Gauteng Department of Agriculture and Rural Development (GDARD).

Figure 2. Ph.D. students, Vuyokazi Mareledwane and Maruping Mangena, getting ready for abattoir sampling

Figure 3. A student analysing test results in the Tuberculosis laboratory at Onderstepoort Veterinary Research

Acknowledgements

Authors

Vuyokazi Mareledwane[1,2,] Abiodun A. Adesiyun[1,3,] Peter N. Thompson[1,] Tiny M. Hlokwe[4#]

[1]Department of Production Animal Studies, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110, South Africa. [2]Vaccines and Diagnostics Programme, Agricultural Research Council-Onderstepoort Veterinary Research, Private Bag X05, Onderstepoort, 0110, South Africa. [3]School of Veterinary Medicine, Faculty of Medical Sciences, The University of the West Indies, St. Augustine, Trinidad and Tobago. 4Diagnostic Service Programme, Agricultural Research Council-Onderstepoort Veterinary Research, Private Bag X05, Onderstepoort, 0110, South Africa.

Please contact the Primary Researcher if you need a copy of the comprehensive report of this project at: HlokweT@arc.agric.za