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Efficacy of a control program for bovine trichomonosis based on testing and culling infected bulls in beef cattle managed under mountain pastoral systems of Northern Spain

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ABSTRACT

Bovine trichomonosis (BT) is a sexually transmitted disease that is considered a cause of early reproductive failure in cattle under extensive management conditions. Recently, *Tritrichomonas foetus* was detected in 41.5% of herds from one representative beef cattle breed (Asturiana de la Montaña; AM) reared in traditional mountain systems in Spain. The objective of the present study was to evaluate the effect of BT on reproductive performance and the economic consequences in AM herds. The benefits of a control program based on testing and culling infected bulls were also studied by comparing *T. foetus* prevalence and reproductive data before and after the implementation of the control measures.

In infected herds, *T. foetus* infection increased calving intervals by 79 days ($P < 0.0001$) and resulted in a higher percentage of cows-not-in calf (36% vs. 19%; $P < 0.001$). An economic analysis showed that BT could reduce income by 68.7% in AM herds. The implementation of the control program decreased calving intervals ($P < 0.0001$) and increased calving percentage ($P < 0.05$). *T. foetus* prevalence showed a significant decline compared with the prevalence before implementing the control program ($P < 0.05$). Nevertheless, after 2 years, the herd prevalence did not decrease (12.7–13.6%; $P > 0.05$) and the herd incidence was 22.72%. The testing and culling policy was effective in improving reproductive efficiency but the complete elimination of BT without substantial changes in management appears unlikely because putative risk factors associated with the disease are present in the management of this breed.

Introduction

Bovine trichomonosis (BT) is a sexually-transmitted disease caused by the protozoan parasite *Tritrichomonas foetus* and is considered an important cause of early reproductive failure in beef cattle. The parasite is found in the preputial mucosa in bulls and reproductive tract of cows. Bulls remain persistently infected and spread infection from cow to cow during natural service (Parsonson et al., 1974; BonDurant, 1997). BT infection increases calving intervals, resulting in reduced calving percentage, and higher culling rates (Clark et al., 1983; Rae, 1989; BonDurant, 2007). Management and control of BT is not easy under extensive management systems (Ball et al., 1987; BonDurant, 2005). It relies upon identification and removal of infected bulls (Rae and Crews, 2006; Yao, 2013) with detection based on a combination of culture and PCR (Felleisen et al., 1997, 1998; Campero et al., 2003; Sager et al., 2007).

Recently, *T. foetus* was detected in 32% of bulls and 41.5% of herds from one representative beef cattle breed (Asturiana de la Montaña; AM) reared in traditional mountain systems in Spain (Mendoza-Ibarra et al., 2012). The high BT prevalence identified in this study, combined with the absence of effective control, means that *T. foetus* infection could be having a significant negative impact on the productivity and sustainability of AM cattle. In Spain, control of BT is voluntary, thus if producers are to make sound decisions regarding BT management and control, reliable information on the impact of infection and the benefits of control is necessary. Field investigations to evaluate the current impact of BT are logistically difficult to conduct, and most published

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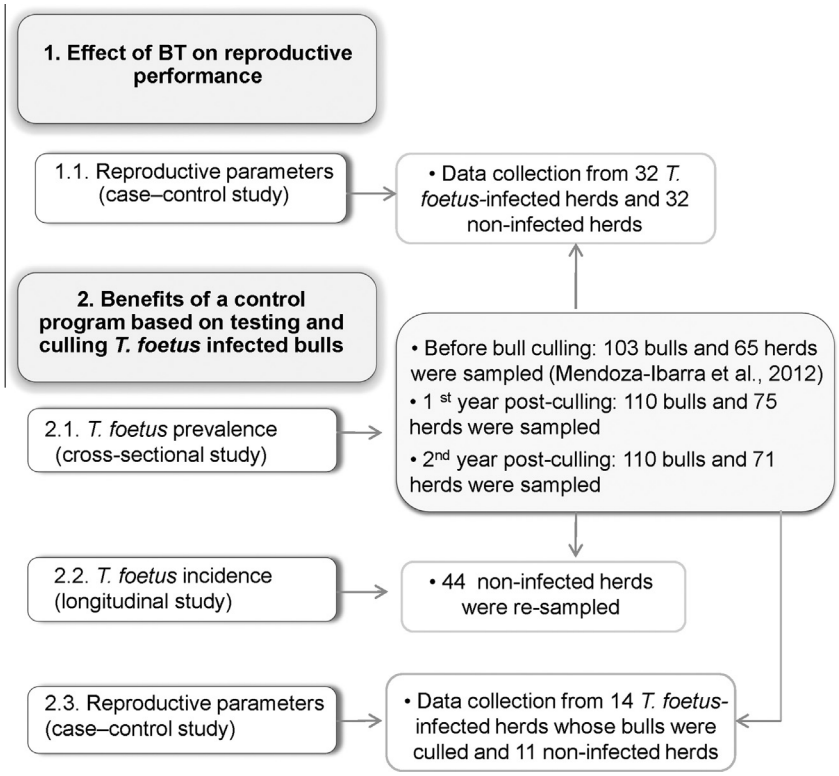

Fig. 1. Study design flow chat. The work investigated the effect of bovine trichomonosis (BT) on reproductive performance (study 1) and the benefits of a control program based on identification and removal of infected bulls (study 2). The effects of the control measures were determined by: (2.1) comparing the prevalence of *T. foetus* infection before and after the implementation of the control plan; (2.2) herd incidence and (2.3) reproductive parameters. The herd participants for each study (studies 1.1, 2.2 and 2.3) were selected from the herds sampled previously (Mendoza-Ibarra et al., 2012) and in the present study for BT prevalence studies.

information is derived from studies under controlled conditions (Clark et al., 1983), computer simulation studies (Rae, 1989), or studies based on data from large-scale cow–calf enterprises (Christensen et al., 1977), in which management procedures could differ from local breeds managed using traditional systems.

Our objective in the present study was to evaluate the effect of BT on reproductive performance and the economic consequences in infected AM herds and to determine the benefits of a control program based on testing and culling infected bulls during an extended observation period of 2 years.

Materials and methods

Mountain pastoral system in AM herds

The present study was conducted on the native AM breed managed under sustainable mountain pastoral conditions and adapted to unfavourable pasture conditions in mountain areas around Picos de Europa National Park in the eastern part of Principado de Asturias (North-western Spain).

Mountain pastoral systems are characterised by the management of cattle in fixed periods, marked by the start and end of summer, with grazing in communal mountain pastures. Mating, mainly through natural mating, occurs in the spring and summer in the meadows close to the holding or in communal pastures in the mountains. Births occur between winter and spring (January–May). Calves travel with their mothers to the mountain pastures, and the suckling/growing period takes 5–7 months. The calves are sold in the autumn at numerous fairs.[2]

Study design and data collection

The first study was a case–control study conducted to evaluate the reproductive impact of BT on AM herds (Fig. 1; study 1). The inclusion criteria were that the herds had been tested for BT and had reproductive records in the database under the custody of the Spanish official AM breeders' organisation (ASEAMO).[2] Herds were classified as 'cases' if at least one sexually active bull tested positive for *T. foetus* and as 'controls' if all bulls in the herd tested negative for *T. foetus*. Participants were randomly selected from the herds tested for BT in both a previous study (Mendoza-Ibarra et al., 2012) and the present study (see below and Fig. 1), providing a final study population consisting of 32 case herds and 32 control herds.

Calving dates and calving percentages were collected from the ASEAMO database. Calving intervals were calculated as the number of days between two consecutive calving dates. Calving percentages were calculated as the number of cows-in-calf divided by the number of cows present in the herd from January to December.

The second study was an evaluation of a *T. foetus* control program based on the detection and culling of infected bulls before the mating season (study 2). The effect was determined by comparing *T. foetus* prevalence before (Mendoza-Ibarra et al., 2012) and after the implementation of the control measures via a cross-sectional study during 2 consecutive years (Fig. 1; study 2.1). The number of herds to be sampled every year was based on the AM herd population (505 herds) and an estimated herd prevalence of 40% (Mendoza-Ibarra et al., 2012), with 10% accuracy and 95% confidence as determined by Win-episcope (version 2.0).

Herds were randomly selected from farms registered in the database of ASEAMO. The targets were AM bulls of breeding age ($\geqslant$18 months) with at least 2 weeks of sexual rest. In the first year after the implementation of control measures, a total of 110 bulls from 75 herds were sampled, and 110 bulls from 71 herds were sampled in the second year. Smegma samples were taken before the mating season (from January to February), when the bulls are separated from the cows, by scraping the preputial cavity with a plastic brush. Samples were examined for *T. foetus*, including culture using 'In Pouch TF' media and by PCR, as previously described (Mendoza-Ibarra et al., 2012). We attempted to collect a sample from every bull in the herd, but 53.3% and 49.3% of the herds were not entirely sampled in the first and second year post-culling, respectively. However, in these herds, a subset of greater than one-half of the bulls were tested (55.6% and 62.9% of the bulls in the first and second year post-culling, respectively), representing the herds mature bull population.

A standardised questionnaire (Mendoza-Ibarra et al., 2012) was completed by the owners to examine the risk factors related to BT. In addition, a longitudinal study was conducted to estimate the herd incidence (Fig. 1; study 2.2). A total of 44 non-infected AM farms were selected from the herds tested for *T. foetus* prevalence studies and were re-sampled at the end of the study. In these herds, all bull populations were surveyed. The herd incidence was calculated as the number of new cases (newly infected herds) divided by the number of herds at risk ($n = 44$). The effect of the program was also determined via a case–control study comparing calving intervals and cows-in-calf percentages during the two consecutive years (Fig. 1; study 2.3).

[2] See: http://www.aseamo.com/.