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Controlling nematodes in dairy calves using targeted selective treatments

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ABSTRACT

With increasing concerns of anthelmintic resistance in cattle nematode populations worldwide, there is a need to explore alternative approaches to nematode control. One alternative approach is the use of targeted selective treatments (TST) where only individual animals are treated instead of the entire group. This study reports the findings of a TST approach in dairy calves conducted over their first grazing season (FGS) to control both gastrointestinal nematode and lungworm challenge. Ninety-six calves with an initial mean (s.d.) age and live weight of 130 (28.3) days and 120 (23.6) kg, respectively, were randomised by breed, age and live weight to one of two treatments; Control ($n = 24$; $\times 2$) and TST ($n = 24$; $\times 2$). Control calves were treated three times at pasture with ivermectin by subcutaneous injection. Individual calves in the TST group were treated at pasture with ivermectin when one of the following thresholds was met: (1) positive for lungworm larvae using the modified Baermann technique or (2) positive or negative for lungworm larvae using the modified Baermann technique with plasma pepsinogen concentration (PP) $\geq$ two international units of tyrosine/litre and faecal egg count (FEC) $\geq$ 200 strongyle eggs per gram of faeces. Calves were rotationally grazed from July 3rd 2012 (day 0) to November 2nd 2012 (day 122) when calves were housed. Calves were weighed and sampled (blood and faecal) every three weeks. There was an effect of treatment and time on both FEC [treatment ($P = 0.023$), time ($P < 0.001$)] and PP [treatment ($P = 0.002$), time ($P < 0.001$)]. Both FEC and PP were higher in TST calves. There was a 50% reduction in anthelmintic use in TST calves compared to control calves. Clinical signs of lungworm infection, confirmed by the modified Baermann technique, were evident in TST calves on days 62 and 63 of the study. The average daily live weight gain for control and TST calves was 0.50 (0.02) kg day^{-1} and 0.47 (0.03) kg day^{-1}, respectively ($P = 0.41$). Thus, performance in dairy calves can potentially be maintained with fewer anthelmintic treatments but farmers need to be vigilant of the challenge posed by lungworm. Any future approach into the use of TST in FGS calves must take into consideration the relative importance of lungworm as a pathogen.

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1. Introduction

Infections with nematodes such as *Ostertagia ostertagi*, *Cooperia oncophora* and *Dictyocaulus viviparus* (lungworm) can impair both the health and performance of first grazing season (FGS) dairy calves in temperate climates. Anthelmintics are central to the control of these infections (van Wyk et al., 2006) and as a result many chemoprophylactic programmes have been designed for FGS dairy calves (Claerebout et al., 1999; Taylor et al., 1995; Vercruysse et al., 1995). Although chemoprophylaxis may not always be warranted in FGS dairy calves for the treatment of gastrointestinal nematode (GIN) infections (Shaw et al., 1997), it will however help to mitigate the effects of challenge due to lungworm, which is important as it is difficult to predict when a disease outbreak due to lungworm challenge may occur. Nonetheless, with increasing reports of anthelmintic resistance (AR) globally in cattle nematode populations (O'Shaughnessy et al., 2014; Sutherland and Leathwick, 2011), anthelmintics need to be used judiciously so as to delay the development of further AR without compromising calf performance.

An example of such an alternative approach to nematode control is the use of targeted selective treatments (TST) (Kenyon and Jackson, 2012) where only individual animals are treated with anthelmintics as opposed to treatment of the entire group. This approach is based on the refugia concept (that portion of the nematode population not exposed to anthelmintics). The aim of this refugia-based approach is to reduce the use of anthelmintics and thus minimise the selection of resistant nematode alleles, thereby increasing the effective lifespan of anthelmintics (van Wyk et al., 2006).

At present, there is little published information on the use of TST-based approaches to nematode control in FGS dairy calves, with the only studies published using live weight gain as an indicator for anthelmintic treatment (Greer et al., 2010; Höglund et al., 2013). Although nematode challenge will account for some of the differences in the live weight gain of FGS dairy calves (Ploeger, 1989), it may not necessarily be the most important consideration as other non-parasite factors including genetic, nutritional, management and other infectious agents may also potentially affect live weight gain. Given the lack of published studies on TST-based approaches to nematode control in FGS dairy calves under temperate conditions, a TST approach guided by parasitological-based indicators and thresholds was investigated. The study objective was to determine the minimum number of anthelmintic treatments required to control challenges due to both lungworm and *O. ostertagi* in FGS spring-born dairy calves under Irish conditions. Previously, these parasites had been identified as the two main pathogenic nematodes to affect FGS spring-born dairy calves in Ireland (Downey, 1973). The study hypothesis was that a TST-based approach controlling for both lungworm and *O. ostertagi* challenge in FGS dairy calves would result in a marked reduction in anthelmintic use without compromising calf performance.

2. Materials and methods

All animal procedures performed were conducted under experimental licence (B100/2869) from the Irish Department of Health and Children in accordance with the Cruelty to Animals Act 1876 and the European Communities (Amendment of Cruelty to Animals Act 1876) Regulation 2002 and 2005.

2.1. Animals and pre-study animal data

Artificially reared weaned dairy calves sourced from 45 commercial farms were used in the study. The calves arrived in batches at the research centre on days -74, -70, -69, -64 and -55 at a mean age (s.d.) of 68 (25.9) days. On arrival, the calves were turned out to pasture separate from the study area and had free access to housing for the first couple of weeks prior to study commencement.

Fifty one spring-born Holstein-Friesian (H-F) and 45 spring-born Hereford × H-F uncastrated male dairy calves with an initial mean (s.d.) age and live weight on July 3rd 2012 (day 0) of 130 (28.3) days and 120 (23.6) kg, respectively, were used.

2.2. Study location and design

The study was conducted on a 9.46 hectare (ha) farmlet at the Animal & Grassland Research and Innovation Centre, Teagasc, Grange, Dunsany, Co. Meath, Ireland (longitude 6°40′ W; latitude 53°30′ N; elevation 92 m above sea level).

On day 0, 96 calves were randomised by breed, age and live weight and assigned to one of two treatments; Control ($n = 24$; ×2) and TST ($n = 24$; ×2). Each treatment consisted of two groups of 24 calves each. All calves in the control groups were treated subcutaneously with ivermectin (1.0 ml per 50 kg bodyweight, Qualimec® 10 mg/ml Solution for Injection, Janssen Animal Health) on days 0, 42 and 84. Individual calves in the TST groups were treated at pasture with the same product at the same dosage rate if any one of the following criteria were met: (1) positive for lungworm larvae using the modified Baermann technique or (2) positive/negative for lungworm larvae using the modified Baermann technique with plasma pepsinogen concentration (PP) ≥ two international units of tyrosine/litre (Utyr) and faecal egg count (FEC) ≥ 200 strongyle eggs per gram of faeces (epg). The study concluded on November 2nd 2012 (day 122) when calves were housed.

2.3. Sample collection

Calves were weighed and blood and faecal samples were collected on day 0, 21, 42, 63, 84, 105 and 122. Individual calf FEC were determined from rectal faecal samples using a modified McMaster method with a limit of detection of 50 epg (Thienpont et al., 1979). Faecal samples were also analysed for the presence of lungworm larvae using the modified Baermann technique as described by Taylor et al. (2007). Plasma pepsinogen concentrations were determined using the method described by Ross et al. (1967).