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A cross-sectional survey of gastrointestinal parasites with dispersal stages in feces from Costa Rican dairy calves

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ABSTRACT

A cross-sectional study was carried out to determine the prevalence of gastrointestinal parasites and lungworm nematodes in dairy calves from five different ecoclimatic areas of Costa Rica. Also intensity of infection of nematodes was determined. In order to describe management practices and anthelmintic control, a questionnaire was applied in 73 farms. The influence of area, farm, host (breed, age) and ecological factors (low and high rainfall period) upon eggs per gram feces (epg) of gastrointestinal nematodes (GIN) and first larval stage counts (L1) of *Dictyocaulus viviparus* were investigated. Furthermore, association of host, ecological and management risk factors to the prevalence of gastrointestinal parasites and *D. viviparus* were analyzed. The most prevalent GIN, cestodes and protozoan identified in dairy farms were similar in all areas studied. Strongylidae was the most prevalent parasite group detected, represented mainly by *Haemonchus* spp. and *Cooperia* spp., whereas *Ostertagia* spp. and *Mecistocirrus digitatus* were barely found. The most prevalent protozoan was *Eimeria* spp. The questionnaire applied to producers revealed the following management practices: weaning age of calves 1–4 months (52.1%), semi-confinement of calves upon 5–8 months of age (41.1%), number of paddocks used for calves <10 (57.5%), first deworming of calves at ages ≥15 days (74.70%) and deworming of calves at intervals >60 days (52.1%). Anthelmintic products were changed in 56.1% of the farms at intervals between 13 and 24 months. Although 91.8% of the farms had veterinary assistance, the majority performed parasite control regimes according to the criteria of the producers (66.7%). Common practices were the dispersion of animal feces on the pastures (64.4%) and use of disinfectant in the milking room (63.4%). The analyses of variance showed significant influence ($p < 0.05$) of age, rainfall period, interaction of rainfall period on area (rainfall period × area) and nested effect of farm within area [farm (area)] on epg of Strongylidae; age, area, rainfall period × area and [farm (area)] on epg of *Strongyloides papillosus*; age, rainfall period and farm (area) on epg of *Trichuris* spp.; rainfall period, rainfall period × area and [farm (area)] on L1 of *D. viviparus*. The logistic regression analyses determined area, semi-confinement, management of feces, use of disinfectant in the milking room as risk factors for the presence of Strongylidae, *S. papillosus* and *Trichuris* spp; rainfall, age, paddock numbers for *D. viviparus*; and area, age, veterinary assistance, deworming program, age at first deworming and use of disinfectant in the milking room for *Eimeria* spp. and *Buxtonella sulcata*.

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1. Introduction

In order to design a rational and sustainable control of gastrointestinal parasites in grazing animals, a comprehensive knowledge of the epidemiology of parasites implicated, the interaction of a specific climate with cattle, management systems practiced and the anthelmintic treatments used are a prerequisite (Borgsteede et al., 1998; Barger, 1999; Yazwinski and Tucker, 2006). These epidemiological factors and their influence will allow determining the presentation and impact of parasitic diseases in dairy cattle in a particular region (Jithendran and Bhat, 1999; Wymann et al., 2007). Several studies carried out in tropical and subtropical areas determined climatic conditions, management practices and anthelmintic control as important factors related to gastrointestinal nematodes (GIN), *Dictyocaulus viviparus* and coccidian infections (Rodríguez-Vivas et al., 1996; Vázquez et al., 2004; Keyyu et al., 2005, 2006; Repossi et al., 2006; Wymann et al., 2007; Pfukenyi et al., 2007; Jiménez et al., 2007, 2008; Abebe et al., 2008).

In Costa Rica, specialized milk production systems represent 46% (6408 farms out of 14,355 farms and 138,000 out of 477,446 animals) of the total dairy cattle farms of the country. In 2009, the production of milk contributed with 36.1 million USD (0.87%) to the gross national product of Costa Rica. These specialized dairy farms are located mainly in high regions of the provinces of Alajuela, Heredia and Cartago, and in these provinces 79.9% of the total milk of the country was produced (CORFOGA, 2001; CNPL, 2010).

Previous studies carried out in Costa Rica reported significant association between gastrointestinal nematodes and meteorological factors (rainfall, maximum and minimum temperature) in one dairy and one beef farm of two different geographical areas, as well as significant effects of factors related to farm structure on the seroprevalence of *D. viviparus* (Jiménez et al., 2007, 2008).

This study aimed to determine the prevalence of gastrointestinal parasites and lungworm nematodes in dairy farms located in different ecoclimatic areas, and to analyze the effect of rainfall period on fecal egg counts (epg) of GIN and first larvae counts (L1) of *D. viviparus*. Furthermore, this study intended to describe management practices and anthelmintic treatments carried out in dairy farms of Costa Rica, in order to determine risk factors associated to infections with GIN, *D. viviparus* and gastrointestinal protozoan in these farms.

2. Materials and methods

2.1. Study area and design

An observational cross-sectional study was conducted in 2006–2007 in five different ecoclimatic areas (Poás, San Carlos, Cartago, Tilarán, Alfaro Ruiz), located in the provinces of Alajuela, Heredia and Cartago, where a high number of specialized milk production systems were reported. A total of 73 farms were analyzed. The number of farms analyzed in each area (Poás 11 out of 40, San Carlos 19/90, Cartago 14/60, Tilarán 11/45 and Alfaro Ruiz 18/75) was determined using a stratified random sampling with a 95% confidence level and an expected prevalence of 50%. A correction factor for finite population was applied (Sheaffer et al., 1996).

Farms located in each ecoclimatic area presented similar meteorological and ecological characteristics. Location and altitude of the farms were obtained from CORFOGA (2001). Meteorological data from the different ecoclimatic areas (overall precipitation during low and high rainfall period and temperature) were obtained from the National Meteorological Institute, San Jose, Costa Rica. Low (January–April) and high rainfall period (May–October) comprised the periods with less and most amount of rain, respectively. The life zones present in the different areas studied were characterized according to Holdridge (1978), based on the mean annual biotemperature, annual precipitation and annual potential evapotranspiration (Table 1).

2.2. Animals

In each farm all animals between 4 and 12 months of age were sampled twice during the low and twice during the high rainfall period in intervals of 15 days, and in sampling intervals of 5 months between low and high rainfall period. A total of 2598 animals (626 Poás, 579 San Carlos, 474 Cartago, 436 Tilarán and 483 Alfaro Ruiz) were sampled in both periods (1275 low and 1323 high rainfall period). The calves received anthelmintic treatment according to the criteria of the farmers. The sampling date was chosen at least 1 month before anthelmintic treatment was applied. During fecal sampling, clinical signs in calves were recorded.

2.3. Parasitological techniques

Fecal samples were subjected to qualitative examination by flotation technique in saturated sugar solution (density 1.3) to detect genera or species of gastrointestinal nematodes eggs. Furthermore, the flotation technique allowed to identify cestodes (eggs) and protozoa (cysts and oocysts) (Sloss et al., 1995).

Eggs per gram feces (epg) were determined only for gastrointestinal nematodes, following the modified McMaster technique (Sloss et al., 1995). Animals with >500 epg GIN were considered to have high intensity of infection, whereas animals with <500 epg were classified as having low intensity of GIN infections (Keyyu et al., 2005, 2006). Fecal first stage larvae (L1) of *D. viviparus* were counted (larvae per 10 g feces) using the Baerman technique (Kassai, 1999) and identified according to Liébano et al. (1997). Positive nematode egg feces samples were processed by coproculture at 27 °C for 1 week (Kassai, 1999). Identification of infective larvae (L3) of Strongylidae was done at genera or species level using pooled fecal samples (Keith, 1952; Bürger and Stoye, 1968; Borgsteede and Hendriks, 1974; Van Wyk et al., 2004). Percentage of L3 of Strongylidae was determined.

In order to identify species of coccidia, 73 pooled (mean of 10 animals per farm) fecal samples were mixed with 2% potassium dichromate solution and placed at room temperature for approximately 1 month to allow oocyst sporulation. Prior to examination, oocysts were con-