Veterinary Parasitology 203 (2014) 227–230

Contents lists available at ScienceDirect

Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar

Short Communication

First survey of endoparasites in pet ferrets in Italy

D. d'Ovidio[a], P. Pepe[b], D. Ianniello[b], E. Noviello[a], Jean-Francois Quinton[c], G. Cringoli[b], L. Rinaldi[b,*]

[a] Private Practitioner, Naples, Italy
[b] Department of Veterinary Medicine and Animal Productions, University of Naples Federico II, CREMOPAR Regione Campania, Naples, Italy
[c] Advetia Veterinary Hospital, Paris, France

ARTICLE INFO

Article history:
Received 20 February 2014
Received in revised form 10 March 2014
Accepted 13 March 2014

Keywords:
Ferrets
Intestinal parasites
Sarcocystis
Ancylostomids
FLOTAC

ABSTRACT

Endoparasites are infrequently reported in ferrets. A cross-sectional survey was conducted to determine the prevalence of intestinal parasites in pet ferrets in southern Italy. Fresh fecal samples were randomly collected from 50 ferrets housed in pet shops or privately owned. All fecal samples were processed using the FLOTAC pellet technique to identify and count helminthic eggs/larvae and protozoan cysts/oocysts. In addition, the samples were analyzed also by the Remel Xpect® *Giardia*/*Cryptosporidium* immunoassay. Intestinal parasites were detected in 15 out of 50 ferrets (30%). Eggs of ancylostomids were found in 28.0% (14/50) of the animals and oocysts of *Sarcocystis* were detected in one ferret (2.0%). None of the samples was positive for *Cryptosporidium* or *Giardia*. To the authors' knowledge, this is the first report of sarcosporidiosis in a pet ferret in Italy.

1. Introduction

In recent years, the popularity of ferret (*Mustela putorius furo*) as a household pet has risen dramatically because of its amicable nature, small size, and relative ease of housing and care. A government study estimated that, by 1996, the pet ferret population in the United States of America was around 800,000 animals (Jurek, 1998). No official data are available in Europe, with the exception of UK where, by 1997, almost 90,000 ferrets were kept as pets (Pantchev et al., 2011). As the number of ferrets increase, so does the need for proper veterinary care (Wolf, 2009). However, despite their increasing popularity, domestic ferrets have been found to be naturally infected with relatively few species of parasites (Powers, 2009; Hoefer et al., 2012). This could result in part from the current husbandry practice of confined or indoor housing for most ferrets or, alternatively, some parasitic infections may be underreported (Patterson and Fox, 2007). However, these small animals can be infected by nematoda, cestoda (see Powers, 2009 for a complete list) and protozoa including *Cryptosporidium* and *Giardia* (Abe and Iseki, 2003; Pantchev et al., 2011).

Parasitological diagnosis is therefore strongly recommended in any ferret with or without clinical signs (Hoefer et al., 2012). A few surveys on the prevalence of endoparasites have been performed in laboratory and pet ferrets (Rehg et al., 1988; Pantchev et al., 2011), nevertheless information on the presence and prevalence of gastrointestinal parasites in pet ferrets in Italy is lacking.

Therefore, the aim of this study was to perform a cross-sectional survey to investigate the occurrence of endoparasites in pet ferrets in southern Italy, using the

* Corresponding author at: Department of Veterinary Medicine and Animal Productions, University of Naples Federico II, Via Della Veterinaria 1, 80137 Naples, Italy. Tel.: +39 081 2536283; fax: +39 081 2536282.
E-mail address: lrinaldi@unina.it (L. Rinaldi).

http://dx.doi.org/10.1016/j.vetpar.2014.03.019
0304-4017/

FLOTAC technique, a highly sensitive method already validated in exotic pets (Rinaldi et al., 2012; d'Ovidio et al., 2014).

2. Materials and methods

In the period April–July 2013, fresh fecal samples were collected from 50 pet ferrets in the province of Naples, Campania region, southern Italy. A convenience random sample of ferrets was performed regardless their health status. Twenty of these animals were kept in pet shops whereas 30 were privately owned. For each animal, the following information was recorded: sex, age, general husbandry and feeding history, source (pet shop vs. private owner), presence of cohabitant pets, and use of antiparasitic treatments.

Samples were taken from the apical region of feces deposited on the ground. The animals were temporary housed in single cages until collection of fecal samples. The samples collected were kept at room temperature until transport to the laboratory where they were refrigerated at +4 °C and analyzed within three days.

All samples collected were processed using the FLOTAC pellet technique (Cringoli et al., 2010) for detection and count of helminthic eggs/larvae and protozoan cysts/oocysts. Two different flotation solutions (FS) were used: FS2 (sodium chloride solution) (1200 specific gravity) and FS7 (zinc sulfate solution) (1350 specific gravity). Parasitic elements were identified, counted, photographed and measured using a light microscope at 200× and 400× final magnification (Leica DFC490). For detection of *Giardia* and *Cryptosporidium*, the specimens were also analyzed by the Xpect® *Giardia/Cryptosporidium* snap test using manufacturer recommendations (Remel Thermo Scientific, Santa Fe Drive, Lenexa, KS, USA).

3. Results and discussion

All the animals included in this survey were asymptomatic and had not received any previous antiparasitic treatment (pet shops animals) or at least in the three months prior enrollment (privately owned animals). Ferrets were fed a pelleted-formulated feed and in 4 cases also raw meat/whole rodent prey. Intestinal parasites were detected in 15 out of 50 (30.0%; 95% Confidence Interval = 18.2–44.8%) pet ferrets. Ten of the positive animals were males, and 5 were females. Nine animals were from pet shops and 6 animals were privately owned. The median age of the infected animals was 2.6 years (range: 0.2–6.0 years). Although, according to the owners, the interaction between ferrets and other pets was extremely rare, 7 privately owned ferrets shared their environment with dogs (5), or cats (2). Noteworthy, these dogs and cats were also evaluated for intestinal parasites and resulted negative.

Ancylostomid eggs were found in 28.0% (14/50) of the examined ferrets and *Sarcocystis* oocysts were detected in one ferret (2.0%). Microscopic photos of the parasitic elements along with the key features are reported in Fig. 1. None of the samples was positive for *Cryptosporidium* or *Giardia* using either the FLOTAC or the Xpect® snap test.

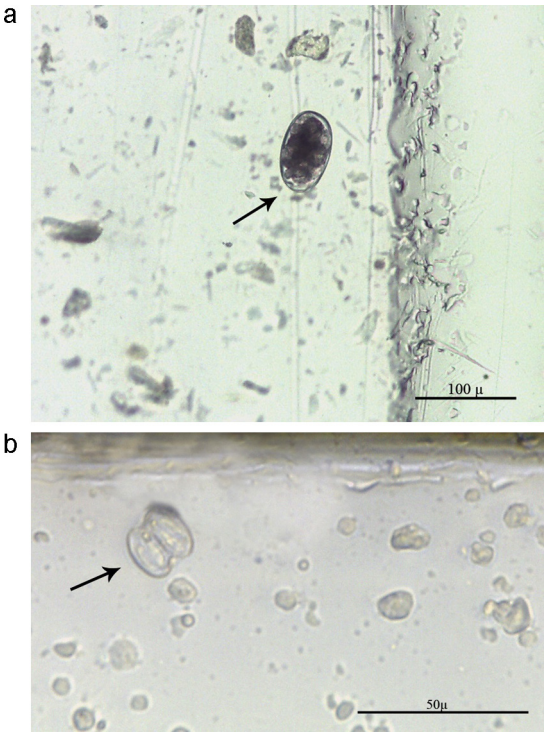

Fig. 1. Parasitic elements detected by FLOTAC in pet ferrets from southern Italy. (a) Ancylostomid eggs. The eggs have an elliptical shape and smooth shell wall and containing a morula, they are 52–92 µm long and 28–58 µm wide. (b) *Sarcocystis* oocysts. The oocysts have a thin wall and containing two sporocysts. Each sporocyst contains four banana-shaped sporozoites. The oocysts are 7–22 µm long and 3–15 µm wide.

The results of this survey showed that the overall prevalence of endoparasites in ferrets was 30%. The most common endoparasites found were ancylostomids (28.0% of the examined ferrets) with a mean value of eggs per gram of feces (EPG) of 53.4 (min = 2; max = 300). Most ferrets infected with nematodes, including ancylostomids, do not show clinical signs, but heavy infections may cause diarrhea, vomiting, and weight loss (Powers, 2009). Ferrets can either be directly infected by ancylostomids or become an accidental host of cat and dog nematodes (Powers, 2009). In the present cases, none of the cohabitant cats and dogs resulted positive for hookworms at copromicroscopic examination, hence a true ancylostomid infection is likely to be occurred in the ferrets enrolled in this survey. The major limitation of the study was the impossibility in identifying at species level the ancylostomid eggs retrieved at copromicroscopic examination. A few surveys have provided helminthological data in wild mustelids from south-western Europe. A recent French survey of helminthes in wild mustelids (e.g. *Mustela lutreola*, *Mustela putorius*, *Mustela vison*) reported a prevalence rate between 50% and 84.6% of ancylostomids (e.g. *Molineus patens*) (Torres et al., 2008). In an Italian survey of parasites in wild mustelids (e.g. *Meles meles*), Magi et al. (1999) reported a prevalence of 84.2% of ancylostomids (e.g. *Uncinaria criniformis*). Recently, Di Cerbo et al. (2005)