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The occurrence of *Codiostomum struthionis* in ostriches (*Struthio camelus*) of different ages and during the dry and rainy seasons at two farms in the State of Rio de Janeiro, Brazil

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ABSTRACT

Ostriches are susceptible to a wide variety of diseases that can affect their commercial breeding. The aim of this study was to identify morphologically *Codiostomum struthionis* and examine its seasonal occurrence among animals of three age categories in two commercial farms in Areal and Itaboraí, State of Rio de Janeiro, Brazil. Fresh fecal samples were collected monthly, from June 2004 to May 2006. Eggs per gram of feces (EPG) were counted after centrifugal flotation in saturated sugar solutions and infective larvae were evaluated after coproculture. A total of 432 fecal samples were collected from three groups according to ostrich age: up to 90 days, 91–365 days and over 365 days (adults). The dry and rainy seasons were defined according to official meteorological data. Typical eggs of the Strongylida order were identified in 242 samples (235 from adult ostriches). Once obtained, infective larvae were identified as *C. struthionis*. Adult ostriches exhibited significantly greater numbers of eggs in their feces during the rainy season compared to the dry season ($p < 0.05$). In the Areal farm, significant ($p < 0.05$) values were found when adults ostriches EPG were compared to ostriches up to 90 days and also for ostriches from 91 to 365 days. When comparing adult EPGs between the two commercial breeding farms, Areal exhibited greater EPGs during both the dry ($p = 0.0215$) and rainy ($p = 0.0011$) seasons.

1. Introduction

Codiostomum struthionis is a nematode found in the large intestine (caecum) of ostriches. Although examinations of ostrich fecal matter can reveal the presence of eggs from the Strongylida order, eggs from *C. struthionis* are indistinguishable from these of *Libyostrongylus* species (Soulsby, 1982). Genus definitive identification requires coproculture to obtain infective larvae, that are morphologically distinguishable (Craig and Diamond, 1996; Ponce Gordo et al., 2002; Ederli et al., 2008a,b). In Brazil, *C. struthionis* has been identified by Bath et al. (2004), Ederli et al. (2008b), Oliveira et al. (2009) and Andrade et al. (2011).

Environmental factors greatly influence the composition and regulation of parasite populations (Stromberg, 1997). Eggs and first stage larvae of *Libyostrongylus douglassii* in feces survived desiccation, being capable of maturing once moistened, and also infective larvae survived in natural conditions for 14 months (Barton and Seward, 1993), thus pasture contamination lasts for long periods of time. Jansson et al. (2002) found that the infective larvae of *L. douglassii* remain viable even at low temperatures;

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additionally, *L. douglassii* is also well adapted to the hot and dry climates found in Africa, which is the natural habitat for ostriches. Unfortunately, equivalent data on *C. struthionis* are not yet available.

The age of the host is also an important determining factor for the occurrence of infections, with young animals usually showing a greater predisposition to certain helminth infections (Soulsby, 1982; Tully and Shane, 1996). However, Bath et al. (2004) identified *Codiostomum* larvae in 21.05% and 20.83% of birds aged 181–365 days and in 36.06% and 55.21% of adult ostriches in farms located in the Tanguá and Itaboraí municipalities, respectively. Ederli et al. (2008b), Oliveira et al. (2009) and Andrade et al. (2011) identified the *C. struthionis* presence in Brazil, but did not correlate it to age of hosts. According to Soulsby (1982), another factor that may influence parasite load is the reproductive period, which affects host immunity.

Ostrich farming in Brazil has greatly increased in recent decades; however, there are few studies investigating the occurrence of *C. strutionis* in ostriches of different ages or the impact of the local climate on *C. struthionis* prevalence.

Given the above, the objective of the present study was to identify infective larvae of *C. strutionis*, examine the influence of seasons and ostrich age on the elimination of nematode eggs (EPG) using data collected from two farms in the municipalities of Areal and Itaboraí, State of Rio de Janeiro.

2. Materials and methods

Samples were collected from two farms in the State of Rio de Janeiro. One farm was located in the municipality of Areal, latitude 22°13′50″ south and longitude 43°06′20″ west; the municipality is at an altitude of 444 m. The climate of Areal is tropical, with the average annual temperature ranging between 20 and 25 °C. The other farm was located in the municipality of Itaboraí, at latitude 22°44′5″ south and longitude 42°51′21″ west; Itaboraí has an altitude of 17 m. The climate of Itaboraí is also tropical.

Male and female ostriches were divided into three age groups: 0–90 days old, 91–365 days old and above 365 days old (adult). Birds were selected for convenience in accordance with the availability of existing animals in each age group. Egg laying is concentrated between June and February, which determines the seasonality of the births.

At the Areal farm, ostriches up to 90 days of age were kept in the maternity ward, where the temperature was controlled and the space was cleaned daily. From 91 to 365 days of age, the birds were separated into lots with up to 12 birds per paddock; after the 365th day, pairs were formed. Ostriches were fed rations (Soma Indústria e Comércio de Alimentos Ltda., Brazil), crushed sugarcane and *Pennisetum purpureum* grass. Generally, throughout the study period, the birds were not vaccinated against any disease or administered anthelmintics. However, in the second half of March 2006, all birds were orally treated with mebendazole (Mebendazole Univet®, Brazil) in the food rations for 10 consecutive days (15 mg/kg).

At the Itaboraí farm, broods were kept in the maternity ward at an approximate temperature of 30 °C. From 91 days of age, birds were normally kept in paddocks with a small covered area; each paddock contained a drinker or water source. Commercial feed (Guabi Nutrição Animal, Brazil) and fodder (*P. purpureum*) were minced twice a day. At adulthood, birds were separated into paddocks where two females per male cohabited. Although birds were not vaccinated against any disease, different age groups of ostriches were treated with the antiparasitic ivermectin 0.2 mg/kg subcutaneous (Ivomec®, Merial, Brazil) during the following time frames: July 2004, birds 91–365 days old; February 2005, birds over 365 days old; May 2005, birds 91–365 days old; and March 2006, birds 91–365 days old.

Samples from the top part of ostrich feces were monthly collected immediately after been dropped, between June 2004 and May 2006 from the two farms in this study. Feces were placed in labeled plastic bags and kept refrigerated (6–10 °C) until examination (at maximum of 24 h after been collected) in the laboratory of the Department of Animal Parasitology of the Universidade Federal Rural do Rio de Janeiro – UFRRJ.

For operational reasons, samples were not collected at Areal in the months of July 2004, April, June and August of 2005, and February and April 2006; additionally, samples were not collected at Itaboraí in April and August 2005 and February 2006.

Each fecal sample was divided into two parts. One part was subjected to centrifugal flotation in a saturated sugar solution (density 1.20–1.25), as detailed by Menezes and Lopes (1995), to enable counts of nematode eggs per gram (EPG). The other portion of the fecal material was used to perform coprocultures. Infective larvae were obtained based on Roberts and O'Sullivan (1950) technique, as explained by Bonadiman et al. (2006), with one exception: feces derived from animals of the same age group, from the same farm and sample date were homogenized. Subsequent count and identification of a hundred larvae (per coproculture) of the nematode genus was made according to the criteria used by Ponce Gordo et al. (2002) and Ederli et al. (2008b).

In the municipalities studied, there was no meteorological station for the collection of data (precipitation, average temperature and relative humidity). Thus, for the years 2004, 2005 and 2006, the data obtained from the Petrópolis municipality, located at latitude 22°30′18″ south, longitude 43°10′44″ west, with 838 m of altitude were used as a reference for Areal, as it was the nearest meteorological station in operation. Data were obtained from SIMERJ (October 2007), the website of the Meteorological System of the State of Rio de Janeiro (Figs. 1 and 2). Based on these data, the dry season was defined as April to September, and the rainy season was determined to be from October to March.

For Itaboraí, data from the municipalities of Maricá and Rio Bonito were obtained from the National Institute of Meteorology (Instituto Nacional de Meteorologia – INMET). Maricá is located at latitude 22°55′10″ south, longitude 42°49′07″ west, and is at an altitude of 5 m. Rio Bonito is located at latitude 22°42′31″ south, longitude 42°36′35″ west, and it is at an altitude of 40 m. For a better approximation of the Itaboraí municipality climate, we calculated the monthly average of the climate data from the two municipalities, Maricá and Rio Bonito (Figs. 1 and 2). However,