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Coccidia of gallinaceous meat birds in Brazil

Coccídios de galináceos de corte no Brasil

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Abstract

Coccidiosis is a disease that limits the production and marketing of gallinaceous birds in North America, especially quails, pheasants and chukar partridges. Virtually no research has been conducted in South America on the causative agents of diseases among these birds, including coccidia. The aim of this work was to make first observations on *Eimeria* spp. in the chukar partridge *Alectoris chukar* and the grey quail *Coturnix coturnix*, which are reared for meat in Brazil. Fecal and tissue samples were collected from commercial farms and were examined for oocysts, gross and microscopic lesions or endogenous stages. From this examination, it was found that partridges raised in Brazil did not have any visible infection. However, grey quails presented mild infection and two *Eimeria* species that had previously been described in other birds were identified.

Keywords: *Eimeria*, infection, diagnosis, oocyst, morphology.

Resumo

A coccidiose é uma enfermidade limitante para a produção e comercialização de aves de corte na América do Norte, principalmente codornas, faisões e a perdiz de chukar. Praticamente nenhuma pesquisa foi realizada na América do Sul sobre os agentes causadores de doenças nessas aves, incluindo coccídios. O objetivo deste trabalho foi realizar as primeiras observações sobre *Eimeria* spp. em perdiz de chukar *Alectoris chukar* e codornas cinzentas *Coturnix coturnix* criadas para abate no Brasil. Amostras de fezes e de tecidos foram coletadas em granjas comerciais e examinadas para oocistos, lesões macroscópicas e microscópicas ou estágios endógenos. Após o exame, verificou-se que a criação de perdizes, no Brasil, não tinha infecção visível. No entanto, as codornas cinzentas apresentaram uma infecção leve e foram identificadas duas espécies de *Eimeria* descritas anteriormente em outras aves.

Palavras-chave: *Eimeria*, infecção, diagnóstico, oocisto, morfologia.

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Introduction

In North America, a relatively large range of exotic gallinaceous birds have been introduced and domesticated in certain areas specifically for hunting. Differently, some of these gallinaceous birds have been reared in South America exclusively for meat. The most popular exotic meat birds belong to the family Phasianidae Horsfield, 1821, which includes species of pheasants, partridges, quails, ducks, geese and doves. The chukar partridge, *Alectoris chukar* Gray, 1930, is a short, round, greyish-brown Eurasian upland bird that has been introduced into many countries and is well established in the United States, Canada and New Zealand for game purposes (WOODARD, 2002). It has been introduced into Brazil because of its fast growth rate. Likewise, the common grey quail, *Coturnix coturnix* Linnaeus, 1758, is marketed in Brazil exclusively for meat, because it is slightly larger than the domestic Japanese quail (*Coturnix japonica*), which is used as an egg-layer. The grey quail originated in Asia Minor and was first domesticated in Europe, but it can be found around the world except in the Americas (BIGLAND et al., 1965). The exotic meat bird industry in Latin America is small and the majority of its flock is located in the state of Santa Catarina in southern Brazil.

It is common knowledge that the parasite with the most negative impact on the economic avian industry worldwide is *Eimeria*. In North America, it is a major limitation to the production and marketing of bobwhite quails, ring-neck pheasants and chukar partridges (DUSZYNSKI & GUTIÉRREZ, 1981; KEENE & SCHWARTZ, 1984; RUFF, 1985). Virtually no research has been conducted on the causative agents of diseases of grey quails and chukar partridges in South America, including coccidia. The aim of this work was to make preliminary observations on *Eimeria* spp. from exotic gallinaceous meat birds marketed in Brazil.

Materials and Methods

This study was conducted on commercial farms integrated with or belonging to BRF S.A., the largest poultry company and the only one raising exotic meat birds in Brazil. The average production was around 50,000 chukar and 510,000 quails, slaughtered weekly at the company's abattoir located in Videira, Santa Catarina.

There was a single chukar farm with a flock separated into categories: three sheds for mothers consisting of wired cages for rearing birds from the age of twelve weeks onwards; and seven sheds for meat birds in which they were reared on the floor in wood shavings between the ages of 1 and 77 days. There were three quail farms, which were also separated into categories: four sheds for mothers, containing caged birds from the age of six weeks onwards and seven sheds for meat birds in which they were kept on bed litter between the ages of 1 and 35 days. All the sheds of all the chukar and quail flocks were studied. While prophylactic anticoccidial treatments were provided by the company to both chukar and quails, the regimen, type of drugs and doses used were not revealed.

Fecal samples from the meat sheds were collected from different points in the bed litter (n = 20). In the mothers' sheds, samples were collected from each cage. A total of 11 sheds on the chukar farm and 33 sheds on the quail farms were sampled. All the samples were kept in plastic bags under refrigeration for transportation purposes. Four birds from each shed were randomly selected to be necropsied for lesion scoring and to collect tissue samples from the duodenum, jejunum, ileum and caeca. The tissue samples were fixed in 10% buffered formalin.

The fecal samples were sieved and stored at room temperature for sporulation in a thin layer of 2.5% w/v potassium dichromate. Oocysts were recovered from the feces after seven days of sporulation, by means of centrifugation in Sheather's solution. The oocysts were photographed for morphological analysis, under an Olympus BX 51 microscope coupled with an Olympus DP71 camera, using the Image-Pro Express 6 software for measurements (CARVALHO et al., 2011). Morphological identification was performed using oocyst length, width, shape index and inner features (DUSZYNSKI & WILBER, 1997). To study the endogenous stages using optical microscopy, tissue samples were prepared in Histosec® (Merck), sectioned at a thickness of 5 µm and stained with periodic acid-Schiff.

Results

All the fecal samples from chukar partridges were negative for *Eimeria* oocysts. This result was confirmed by means of gross and microscopic examination, which showed that lesions or endogenous stages of *Eimeria* were absent from the tissue samples. These findings, together with the flock history and lack of clinical signs, suggest that chukar partridges reared in Santa Catarina do not have any visible coccidial infection. The fecal samples from all the quail farms were positive for *Eimeria*, but the oocyst numbers were very low. According to the morphological characteristics of the oocysts found (Table 1), two *Eimeria* species that had previously been described were identified in the quail samples (Figure 1). The most prevalent of these was *E. bateri* Bathia, Pandey & Pande, 1965 (80.31%), followed by *E. tsunodai* Tsutsumi, 1972 (9.69%). No specific macro and microscopic lesions were observed in the tissues from the quails. Endogenous stages were observed mostly in sections from the upper and descending small intestine of quails. The parasites were located at the base of the villi, towards the glands. Occasional mature schizonts (mean size 8.7 × 7 µ) were observed within the duodenum and ileum sections of young meat quails (23 days of age). They were generally located above the nucleus of the host cell. Gametocytes occurred throughout the small intestine but were more concentrated in the jejune of meat quails. Mature macrogametocytes (mean size 20.5 × 11 µ) were more numerous than microgametocytes (mean size 19.8 × 12 µ). No schizonts or gametocytes were observed in the sections from the intestine of adult caged quails.

Discussion

The prevalence and identity of the coccidia of exotic meat birds in the Brazilian poultry industry has never been assessed. Coccidiosis is the most frequent parasitic disease of the poultry industry worldwide and it is uncommon to find *Eimeria*-free flocks

Table 1. Comparative morphology of *Eimeria* oocysts from the *Coturnix* quail.

Eimeria Specie	Authorship	Host	Oocyst			Shape Index	Walls	Polar Granule	Micropyle	Sporocyst		Stieda Body	Substieda Body
			shape	Length (µm)	Width (µm)					Length (µm)	Width (µm)		
E. dispersa	Tyzzer et al. (1929)	*C. coturnix*	ovoidal	17.2-26.4	15.4-22.4	*	1	*	absent	*	*	*	*
E. coturnicis	Chakravarty & Kar (1947)	*C. coturnix*	ovoidal	26.4-38.8	19.8-26.4	*	2	1	absent	13.2-17.2	8.8-11	knob-like	*
E. taldykurganica	Svambaev & Utebaeva (1973)	*C. coturnix*	ovoidal	21.88-25.4	11.9-13.1	1.86	2	1	absent	8.1-11.6	3.59-4.8	*	*
E. tahamensis	Amoudi (1987)	*C. delegorguei*	ellipsoidal	36.5-42	25.5-29	*	2	1	absent	14-16	9-11.5	knob-like	*
E. uzura	Tsunoda & Muraki (1971)	*C. japonica*	ellipsoidal-ovoidal	18.75-30	15.0-23.75	1.31	2	0-4	present	*	*	*	*
		C. japonica	ovoidal	18.86-	15.04-	1.32	2	2-4	absent	11.02-	5.49-	Piriform	*
	Teixeira & Lopes (2002)	*C. japonica*	ovoidal	22.76	17.42	1.3	2	5	absent	12.5	6.39	Knob-like	present
	Berto et al. (2013)			18-28	16-21					13-14	5-7		
E. tsunodai	Tsutsumi (1972)	*C. japonica*	ovoidal	15.5-22.5	16.5-18.5	1.3	2	0-5	absent	10.3-	5.-6.1	triangular	present
	Teixeira & Lopes (2002)	*C. japonica*	ovoidal	18.7-21.7	14.09-	1.36	2	1-2	absent	11.5	5.09-	triangular	present
		C. japonica	subspherical-ellipsoidal	18-25	15.67	1.3	2	1-2	absent	9.81-	5.69	nipple-	present
	Berto et al. (2013)	*C. coturnix*	ovoidal	19 - 24	14-19	1.4	2	1	absent	11.01	5-6	triangular	present
	Present work				13.7 - 16					10-12	5.3-8	nipple-triangular	
										10-12.8			
E. bateri	Bathia et al. (1965)	*C. coturnix*	ellipsoidal, ovoidal or	15-28	14-23	1.26	2	1	absent	9-13	5-8	promi-	*
	Teixeira & Lopes (2002)	*C. japonica*	sub spherical	19.66-	15.04-	1.32	2	1	absent	9.66-	6.08-	nent	*
		C. japonica	ellipsoidal, ovoidal or	23.34	17.68	1.3	2	1-2	absent	11.8	7.24	promi-	present
	Berto et al. (2013)	*C. coturnix*	sub spherical	18-31	14-26	1.33	2	1	absent	10-13	6-8	nent	present
	Present work		ellipsoidal, ovoidal or	17.6-	14.6-20					8.44-	5.91-	nipple-	
			sub spherical	28.15						13.16	9.35	like	
			ellipsoidal, ovoidal or									nipple-	
			sub spherical									like	

*Not presented in the original description.

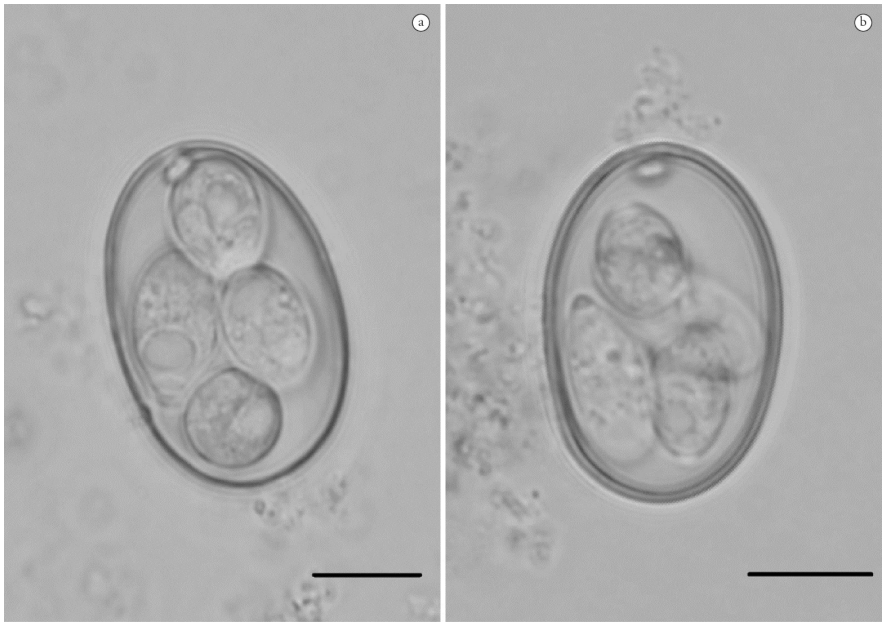

Figure 1. Sporulated oocysts of (a) *Eimeria bateri* and (b) *E. tsunodai* in Sheater's solution (scale bar = 10μm).

(RUFF et al., 1984). However, according to the data presented here, coccidiosis is very well controlled in both the chukar and the quail farms in Santa Catarina, Brazil. The absence of infection in the chukar partridges could be due to the fact that these birds were introduced through egg importation from Europe. Consequently, no infected birds were introduced into Brazil. Moreover, egg hatching takes place under restricted conditions without any presence of circulating *Eimeria* species that might be able to infect these birds. This is probably due to host specificity (BIGLAND et al., 1965; EDGAR et al., 1964; SHAH & JOHNSON, 1971; LONG & MILLARD, 1979; FAYER, 1980; LONG & JOYNER, 1984). Furthermore, prophylactic use of anticoccidial drugs and biosecurity measures may also have strengthened the limitation of infection among these chukar partridges.

Making a morphological diagnosis of *Eimeria* is often difficult because of similarities in oocyst morphology and infection sites. According to Ruff (1986), the taxonomic status of game bird coccidia is still in disarray, because different hosts may harbor different *Eimeria* species and cross-infections may not be entirely ruled out. This problem might be reduced through development of novel diagnostic methods (KUCERA & REZNICKY, 1991; DAUGSCHIES et al., 1999). However, application of molecular diagnostic techniques depends on construction of PCR primers for detecting and distinguishing *Eimeria* spp. This technology remains unavailable for most exotic birds (GERHOLD et al., 2011). Thus, morphological differentiation in association with assessment of host specificity is still useful in characterizing *Eimeria*.

In *Coturnix* quails, six *Eimeria* species are known (Table 1) and three have been reported in Brazil (TEIXEIRA et al., 2004; BERTO et al., 2013). *Eimeria bateri*, a parasite originally described from Indian quails, seems to be well distributed worldwide (SHAH & JOHNSON, 1971). This species was found to be able to infect and develop its entire life cycle in Japanese quails (NORTON & PEIRCE, 1971). However, there are very few acceptable records of transmission of *Eimeria* species from one host genus to complete development in another, with the exception of situations that may reflect a close systematic relationship between two hosts (DORAN, 1978; LONG & JOYNER, 1984). In a similar situation, Japanese quails were infected in a laboratory with *E. dispersa*, which is known to be a parasite of partridges and grey quails, but not of chickens or turkeys (EDGAR et al., 1964). Because *Coturnix coturnix* and *Coturnix japonica* are phylogenetically related birds, *E. bateri* and *E. tsunodai* may infect both hosts.

The other four species that have been described in *Coturnix* quails have oocysts that differ from those reported here. The oocysts of *E. dispersa* are slightly larger, have no polar granule and have a single wall. Those of *E. coturnicis* are considerably larger and contain sporocysts in which the sporozoites lie at opposite poles along the transverse axis and residuum is present. Oocysts of *E. uzura*, *E. tahamensis* and *E. taldykurganica* also differ in size, shape and shape index from those described here.

The presence of endogenous stages within the small intestine of young quails seen in our study was concordant with the form and location described in previous life cycle studies (NORTON & PEIRCE, 1971; TSUTSUMI, 1972). This also suggests that young quails reared on the floor are more susceptible to infection. Even in situations of mild infection, constant monitoring of *Eimeria* incidence is necessary, particularly in younger categories, since this represents a threat to the livestock business if left unchecked.

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