

Coccidian Oocysts and Sporocysts Isolated from Dogs (*Canis familiaris*) Fed Camel (*Camelus dromedarius*) Meat

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ملخص البحث

في هذا البحث تم التعرف علي خمسة أنواع من كوكسيديا الأنسجة في الإبل بولاية القضايف بشرق السودان عن طريق إطعام مجموعة من الجراء الفطيمة أجزاء نية من مريء ولسان و الحجاب الحاجز وقلب وعقد ليمفاوية و عضلات ابل جمعت من مسلخ مدينة القضايف. عند فحص براز تلك الجراء بعد مضي 9-10 و 9-13 يوم تأكد احتوائه علي أكياس بيضية (oocyst) وأبواغ كيسية (sporocyst) علي الترتيب. بعد قياس تلك الأكياس البيضية (8-20 x 5-26 و 5-22 x 5-16 ميكرومتر، 5-18 x 5-19 x 5-15 و 9-18 ميكرومتر و 10-13 x 9-11 ميكرومتر) تم التعرف علي هوية طفيلياتها وهي الكيسية ذات الأبواغ المتماثلة الاوهايويه (*Cystoisospora ohioensis*) والكيسية ذات الأبواغ المتماثلة البروزيه (*Cysto burrowsi*) و همونديا الهيدرورنيه (*Hammondia heydorni*). اما الأبواغ الكيسية (5-9 x 9-11 و 5-11 ميكرومتر و 2-13 x 5-13 و 5-6 x 5-9 ميكرومتر) فكانت لنوعين لطفيي المتكيسة اللحمية (*Sarcocystis*) هما المتكيسة اللحمية للإبل (*Sarcocystis cameli*) ونوع آخر من المتكيسة اللحمية (*Sarcocystis sp*) لم يسمي بعد. أثبتت هذه التجربة وجود نوعين من كوكسيديا الأنسجة (*Sarcocystis*) ينتقلان بين الإبل و الكلاب في السودان.

Summary

Raw cameline meat (composite of oesophagus, tongue, diaphragm, heart, lymph nodes and skeletal muscles) collected from animals slaughtered at El Gedarif city, mid-eastern Sudan, was fed to weaned puppies.

The puppies started to shed coccidian oocysts 9-10 days and sporocysts 9-13 days after infection. These oocyst measured 20.8-26.5 µm X 16.5-22.0 µm, 18.0-19.5 µm X 15.5-18.9 µm and 10.0 µm 13.0 µm X 9.0-11.0 µm and were identified as *Cystoisospora ohioensis*, *Cystoisospora burrowsi* and *Hammondia heydorni*, respectively. Two types of *Sarcocystis* sporocysts were excreted by the puppies. They measured 16.0 µm X 9.9-11.5 µm and 13.2-13.6 µm X 6.5-9.5 µm, respectively. One type of these sporocysts was identified as *Sarcocystis cameli* and the other was designated as *Sarcocystis sp*. These results represent the first record of isolation for *Cystoisospora burrowsi* and *Cystoisospora ohioensis* from cameline tissues. Moreover, the results confirm the existence of at least two different species of *Sarcocystis* transmissible between the dog (*Canis familiaris*) and the camel (*Camelus dromedarius*).

Introduction

The dog (*Canis familiaris*) is known to act as a final host for at least 13 species of tissue-cyst forming coccidia in mammalian species. These animals act as intermediate hosts and support the formation of tissue cysts by the parasite. The camel (*Camelus dromedarius*) was reported to support the asexual development of *Sarcocystis cameli* (Mason, 1910; Hilali and Mohammed, 1980 and Hilali *et al.*, 1992) and *Hammondia heydorni* (Nassar *et al.*, 1983; Warrag and Hussein, 1983; Hilali *et al.*, 1992). To the best of our knowledge, there is no report on the dromedary involvement in transmission of other tissue-cyst forming coccidia of the dog. The present study was initiated to investigate the possibility of presence of other isosporidian tissue-cyst forming coccidia that associate the domestic dog with the dromedary in a predator-prey relationship.

Materials and Methods

Seven weaned 4 weeks old puppies were reared in separate clean kennels at the premises of the Department of Parasitology, Faculty of Veterinary Science, University of Khartoum. The puppies were kept on pre-boiled cow's milk mixed with bread throughout the experimental period (82 days). Six of these puppies were fed once on raw camel meat at 6 weeks of age. Each of the six puppies was fed 400g of minced composite meat consisting of oesophagus, tongue, diaphragm, lymph node, heart and skeletal muscles that were collected from camels slaughtered at El Gadaref slaughterhouse in mid-eastern Sudan. One puppy which was not fed on the meat samples was kept as the experimental control. Faecal samples were collected daily from each puppy and examined for presence of coccidian oocysts and/or sporocysts using the sugar flotation technique. Oocysts and/or sporocysts dimensions were measured by a calibrated compound microscope (Zies, standard 20, Germany). Prepatent and patent periods of infections were recorded. The detected oocysts were sporulated at 20-30°C in 2.5% potassium dichromate solution. Portions of the composite meat samples were preserved in 10% formal-saline solution and prepared for histosections.

Results

The puppies started to shed coccidian oocysts 9-10 days and sporocysts 9-13 days after feeding on raw cameline meat. The oocysts discharged were identified as *Cystoisospora ohioensis*, *Cystosisospora*

burrowsi and *Hammondia heydorni*. The patent periods were 2-9, 5-7 and 13-18 days for these parasites, respectively (Table 1). Two types of sporocysts were excreted by the puppies and were designated as *Sarcocystis sp.* and *Sarcocystis cameli*. The patent periods were 37-45 days and 55-57 days for each *Sarcocystis sp.* type, respectively (Table 1).

Table 1: Prepatent (PR) and Patent (P) period (days) of coccidian parasites in dogs fed camel's composite meat

Dog No.	<i>Cystoisospora ohioensis</i>		<i>Cystoisospora burrowsi</i>		<i>Hammondia heydorni</i>		<i>Sarcocystis sp.</i>		<i>Sarcocystis cameli</i>	
	PR	P	PR	P	PR	P	PR	P	PR	P
	9	7	9	7	9	15	11	39	9	57
2	9	7	9	7	9	15	13	37	9	57
3	9	9	10	5	9	15	9	45	11	55
4	10	5	9	7	9	18	9	37	9	55
5	9	2	9	7	9	15	10	37	13	55
6	9	7	10	5	10	13	13	37	9	57

The morphological characteristics of the oocysts and sporocysts recovered were as follows:

***Cystoisospora burrowsi*:**

The unsporulated oocysts were ellipsoidal, had smooth double layered-wall and devoid of both micropyle and residual body (Fig. 1). They contained one or two sporonts and a residual body (Fig. 1), measured 18.0-19.5 μm x 15.5-18.0 μm and sporulated after 2-3 days. Sporulated oocysts contained two sporocysts that measured 12-15 μm X 6-8 μm and contained 4 sporozoites each.

***Cystoisospora ohioensis*:**

The unsporulated oocysts were ellipsoidal, with smooth double layered wall, contained one or two sporonts and without a micropyle structure (Fig. 2). They measured 20.8-26.5 μm x 16.5-22.0 μm . Sporulation was completed within 3 days. Sporocysts measured 14-18 μm x 8-11 μm ; and each sporocyst contained 4 sporozoites with clear sporocystic residual body.

***Hammondia heydorni*:**

The unsporulated oocysts were spherical or subspherical, with smooth single layered wall, and without a micropyle (Fig. 3). Oocysts measurements were 10-13 μm x 9-11 μm . Sporulation was complete within 3 days and sporulated oocysts contained 2 sporocysts measured 8 μm X 5 μm and each sporocyst contained 4 sporozoites.

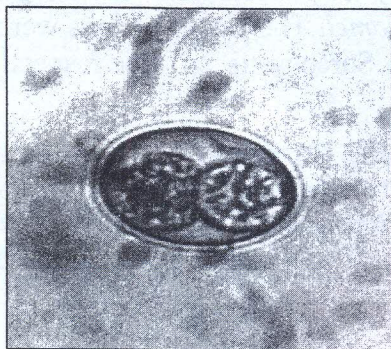


Fig. 1: Unsporulated oocyst of *Cystoisospora burrowsi* (X800)

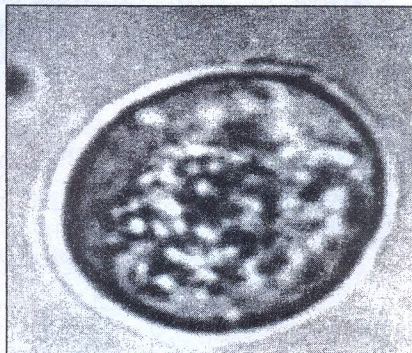


Fig. 2: Unsporulated oocyst of *Cystoisospora burrowsi* (X800)

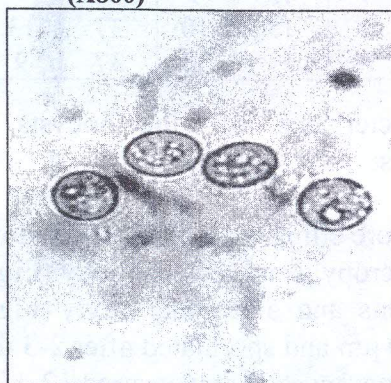


Fig. 3: Unsporulated oocysts of *Hammondia heydorni* (X1600)



Fig. 4: *Sarcocystis cameli* sporocysts (X1600)

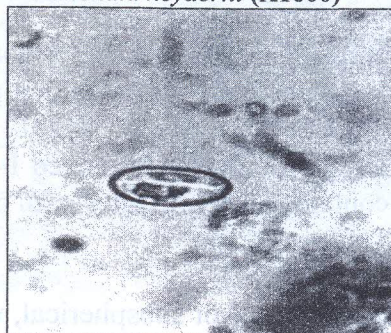


Fig. 5: *Sarcocystis* sp. Sporocysts (X1600)



Fig. 6: Sarcocyst between the skeletal muscle fibres of camel diaphragm (X400)

Sarcocystis cameli:

The sporocysts were ellipsoidal, had smooth wall with one side being more convex than the other and measured 13.2-13.6 μm X 6.5-9.5 μm . Each sporocyst contained four overlapping banana-shaped sporozoites with clear sporocystic residium (Fig. 4).

Sarcocystis sp:

The sporocysts were ellipsoidal and had smooth colourless walls with one side being more convex than the other and measured 16.0 μm x 9.9-11.5 μm . Each sporocysts contained 4 banana-shaped sporozoites and a residual body (Fig. 5).

Histopathology:

Histological examination of meat samples revealed the presence of one type of sarcoystis tissue cyst between the muscle fibers of the diaphragm (Fig. 6). This cyst measured 430 x 124.0 μm and was enclosed by two layers; an outer thin layer and an inner thick layer from which strands of material extended into the cavity of the cyst, thus dividing it into compartments.

Discussion

This study shows that at least 5 different species of tissue cyst-forming coccidia are transmissible between the dromedary and domestic dog. These are *Cystoisospora burrowsi*, *Cystoisospora ohioensis*, *Hammondia heydorni*, *Sarcocystis cameli* and *Sarcocystis sp.* This is the first record for the detection of *Cystocystis. burrowsi* and *Cystocystis. ohioensis* in dogs being fed on cameline meat. The morphological characteristics of *Cystocystis. burrowsi* described in this study conform with those reported by Levine (1978) and Trayser and Todd (1978). Likewise those of *Cystocystis. ohioensis* conform to Dubey (1975) and Levine (1978) descriptions. Both species were reported to occur in various mammals including buffalo (Gill et al., 1978) and sheep (Hilali et al., 1992). It is acceptable in the light of the biological characteristics, that heteroxeneous canine coccidia are grouped under the genus *Cystoisospora* (Frenkel, 1977). Despite their rigid definitive host specificity, these parasites are facultative in parasitizing intermediate hosts.

As shown in this study *H. heydorni* is transmissible between dogs and camels. This finding conforms with the previous reports of Nassar et al. (1983), Warrag and Hussein (1983) and Hilali et al. (1992).

Two types of *Sarcocystis* sporocysts were recovered from dogs fed on cameline meat. The morphological and biological characteristics of one type of these sporocysts were consistent with those reported by Hilali and Mohamed (1980) and Hilali *et al.* (1992) for *Sarcocystis cameli*. On the other hand, the other type of sporocyst referred to in this study as *Sarcocystis sp.* had larger dimensions (16.0µm x 9.9-11.5µm) and had a shorter patent period (37-45 days) which are indicative of another species of *Sarcocystis* transmissible between dogs and camels. It is worth noting that Mason (1910) in his original report on the occurrence of sarcocystosis in the dromedary described two different types of tissue cyst, and named the parasite *Sarcocystis cameli* as he interpreted the two cases to be different developmental stages of the same parasite. Furthermore, Abdel Ghaffar *et al.* (1979) in their ultrastructural studies of *Sarcocystis sp.* of the camel in Egypt described *Sarcocystis* with peculiar structures in the oesophageal and diaphragmatic striated musculature. This situation caused them to refrain from coding the species name given by Mason (1910). It is possible, therefore, that two different species of *Sarcocystis* are transmissible between dog and the dromedary.

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