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Cockroaches as transport hosts of the protozoan *Toxoplasma gondii*

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Resumen: Las cucarachas *Eurycotis biolleyi* y *Blatella germanica* ingieren heces de gato aún en presencia de azúcar, queso o masa de maíz. Además, los ooquistes de *Toxoplasma* pueden mantenerse viables externa e internamente en esos insectos hasta 19 días después de la exposición experimental. Se agregan así dos nuevos vectores mecánicos en la trasmisión del *T. gondii*.

Key words: *Toxoplasma*, cockroaches, epidemiology, transmision.

The transmission of *T. gondii* is related with raw meat (Frenkel 1973) or oocyst ingestion. Oocysts are shed by cats (Jewell *et al.* 1972) and in the soil they are extremely resistant to environmental conditions (Frenkel et al. 1975). Oocyst infection occurs by fecal oral contamination and may involve transport hosts such as house flies (Wallace 1971) or cockroaches (Wallace 1972). In previous studies, we demonstrated that *Periplaneta americana*, *P. australasiae* and *Leucophea maderae* ingest cat feces, and maintain viable *T. gondii* oocysts in their intestine for several days (Chinchilla and Ruiz 1976). Based on these findings we studied the role of *Eurycotis biolleyi* and *Blatella germanica* in the transport of oocysts, determining if they eat cat feces and how much they keep viable parasites inside the digestive tract.

To demonstrate that cockroaches consume cat feces even in the presence of other food, 25 insects of each species were placed in a box of 40x24x15 inches with fresh or dried cat feces, sugar, corn dough or cheese. All of these materials were impregnated with diferent vital dyes (Ancla Laboratory, San José, Costa Rica) as to detect their presence in feces. After 48h the animals were dissected and the material from the intestine was disolved in water and passed through a 30 cm Sephadex G-50 column to separate the dyed contents (Chinchilla and Ruiz 1976).

We demonstrated that both species of cockroaches ingest cat feces even in presence of other common food (underscored data, Table 1). These findings agree with previous work on other Blattaria species (Chinchilla and Ruiz 1976). Since cat feces may contain *Toxoplasma* oocysts, it is important to determine their survival time in the insects. To demonstrate mechanical transport and survival of the parasite, cockroaches were fed sugar with 10^6 *Toxoplasma* oocysts (TCR-2 or TCR-3 strains) and then studied for several days according to the following methods. Each insect was placed in a glass tube covered with a cotton plug. After different periods the insect was removed from the tube, washed with 1 ml

TABLE 1

*Cat feces ingestion by cockroaches in presence of other food**

Food	*Blatella germanica* N°	*Eurycotis biolleyi* N°
Cat feces fresh	*4/14+*	*5/12*
Cat feces dried	*8/14*	*5/12*
Sugar	6/14	8/13
Corn dough	12/25	11/12
Cheese	4/14	9/12

* These experiments were repeated with similar results.
\+ Number of positive insects / total.

of sterile saline solution and then dissected to extract the intestine. In adition 1 ml of saline solution was added to the tube to recover remanent oocysts.

Washing from the tube, the insect and the intestinal contents were inoculated per os into separate mice to test presence of viable oocysts. The survival time of inoculated mice was recorded, and those that survived after 30 days analized for *Toxoplasma* cysts and antibody presence. Table 2 shows clearly that these two cockroach species not only transport viable oocysts in the body surface, but also keep them in the intestine for as long as 19 days. Similar results were found for *Toxoplasma* TCR-3 strain.

E. biolleyi and *B. germanica* usually live inside houses in rural areas and open markets, becoming active at night and to forage in tables, dishes, etc. We have demonstrated that they also eat cat feces. In this way insects transport the *T. gondii* oocysts to any food carrying them in the body surface or in the intestine. In Costa Rica and probably in many other countries, *Toxoplasma* infection is very high in cats (Ruiz and Frenkel 1980); thus contamination of cockroaches is likely. Therefore, the role of these insects in the dissemination of *Toxoplasma* is probable since they will contaminate food that can infect home rodents and cats. At the same time, human beings will be infected when ingesting such food. Moreover we have tested two isolated Toxoplasma strains characterized in Costa Rica (Holst and Chinchilla 1990, Guerrero *et al.* 1991) and in both oocyst survival time in the intestine is similar, which means that the transmission by these insects is independent of the parasite source.

This paper adds two new species of roaches to the list of *Toxoplasma* transport hosts (Ruiz and Frenkel 1980) that have been reported.

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TABLE 2

Results of mouse inoculation with washings or intestinal contents of cockroaches exposed to T. gondii *oocysts*

Infection time (days)	*Eurycotis biolleyi*			*Blatella germanica*		
	t.w.	i.w.	intest.	t.w.	i.w.	intest.
2	T	ab	C	n.d.	n.d.	n.d.
5	T	ab,C	ab	ab,C	ab,C	ab
6	T	ab	ab,C	T	ab,C	T
7	ab,C	ab,C	ab,C	ab		
9	ab,C	ab	ab	ab,C	ab	ab
10	ab,C	ab	ab	n.d.	n.d.	n.d.
19	T	ab,C	ab,C	ab,C	ab	ab

T = tachyzoites in peritoneal exudate.
ab = antibodies
C = brain cysts
t.w. = tube washing
i.w.= intestine washing
n.d. = not done

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