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Contamination and Viability of *Toxocara* sp. in Feces Collected from Public Parks, Streets and Dogs in Tejupilco at the Subhumid Tropic of Mexico

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Abstract: The contamination and viability of *Toxocara* sp. eggs in Tejupilco parks, Mexico was studied incubating samples to evaluate the infestation potential from fecal samples collected from dogs with owners and in soil, streets and home gardens near of the parks. Toxocara contamination in the soils of the parks was 24.68% with a viability of 60.88%. Contamination in home gardens was 19.5% with as viability of 49.21% and the streets shoed similar values of contamination (20.33%) with reduced viability (20.33%). The dogs had a 34.22% infestation being viable 93.75% of their eggs. The number of eggs were correlated with the larva viable ($r = 0.97$, $p<0.02$). Results indicated that dogs, parks and the surrounding areas (streets and home gardens) are sources of potential infestation of the Toxocara and it is important to reduce the risk of transmission to humans by removing feces and controlling the parasites in dogs.

Key words: Toxocara, zoonosis, parks, contamination, dogs, transmission

INTRODUCTION

Toxocarosis is entheroparasitosis frequently present in dogs and cats which is maintained in the environment by the infestation and re-infestation of the hosts by the ingestion of food and soil contaminated with larvated eggs, ingestion of larvae in tissue of paratenic larvae (rats, birds) by transplacentary migration of a female dog to their fetus, transmamary passage in milk or ingestion of larvae or feces from puppets infested (Archelli and Kozubsky, 2008). Humans, mainly children are infested by the accidental ingestion of embryonated eggs from the soil contaminated by the dogs and even when most of the seropositive patients may be asymptomatic, the parasite may cause fever, hepatomegaly, esplenomegaly, hypergammaglobulinemia, eosinophilia, adenopathies and disorders of central nervous system, myocardium, eyes, skin, respiratory symptoms and even as a fatal disease (Camparoto *et al*., 2008; Rubinsky-Elefant *et al*., 2010).

There are several reports in the world of Toxocara contamination in public parks where children and dogs have access (Shimizu, 1993; O'Lorcain, 1994; Fonrouge *et al*., 2000; Ruiz *et al*., 2001; Cazoria *et al*., 2007; Romero *et al*., 2009) but little information is reported from home gardens and streets (Vazquez *et al*., 1996). More importantly is that reports of the viability of Toxocara eggs are almost nonexistent (Vazquez *et al*., 1996) or have been performed experimentally in laboratory rats (Sommerrfelt *et al*., 2002), so it is important to know the viability of parasites in parks, gardens or streets where children may be contaminated. It must be present that has been reported that toxocara eggs may survive until 3 years in the soil (Ghiani, 2001) and the infective potential of a dog may varies from 15,000-200,000 eggs per day (Schantz and Steher-Green, 1988; Kerr-Muir, 1994).

Even when it is clear the relationships between the parks, the surrounding areas and the dogs (Vasquez *et al*., 1996; Laird *et al*., 2000) most of the studies present a partial part of the problem (Andresiuk *et al*., 2003; Cazoria *et al*., 2007; Romero *et al*., 2009) therefore, the objective of this study was to evaluate the contamination and viability of Toxocara eggs in different areas and dogs sampled in a city located in a subhumid region of Mexico in order to improve the understanding of this zoonotic disease and the possible potential of infestation of each area.

MATERIALS AND METHODS

The city selected for the study was Tejupilco which is located at 1340 m altitude which a subhumid and semihot climate ((A)C(w)) with seasonal variations (dry season from November through May and rainy season from June through October) (Garcia, 1973). Feces in soil

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were collected in four municipal parks, collecting soil every 100 m^2 (Sommerrfelt *et al*., 2002) with a total of 679 samples. Also fecal samples in home gardens were collected near to the parks (40 samples in each one) with a total of 200 samples whereas in the streets, feces were collected in distances to 100-200 m from the parks with a total of 171 samples.

Finally, a total of 221 fecal grab samples from dogs with owner were obtained (Romero *et al*., 2009). The *Toxocara* sp. diagnosis technique performed on the feces was by sedimentation and flotation (Thienpont *et al*., 1978; Lopez *et al*., 2002). The proportion of contamination was considered as the percentage of the positive samples from the collected samples (Habluetzel *et al*., 2003).

In order to determine Toxocara eggs viability, first were washed with saline solution (0.9%) and then mixed with 25 mL formol at 0.5% and 0.01 mL iodopovidone at 10% and then incubated in Petri dishes at 35°C. Larvas were counted every 7 days until 42 days. For this procedure, 2 mL were homogenized and was used the sedimentation-flotation technique with a saturated solution of magnesium sulfate (Quinn *et al*., 1980).

The counting was conducted in a Mc Master chamber with a dilution factor of 1:100 (Sommerrfelt *et al*., 2002). To establish that the larvae has the infestation potential, a drop of the homogenized was collected from positive samples for larvae development and were observed under microscope (100X) confirming the complete morphology, checking motility. Results were expressed as a percentage of viable samples collected as well as number of eggs and larva per gram of feces (Laird *et al*., 2000).

Normality of all variables was tested and a variance analyses was performed to compare among parks with a Tukey tests ($p<0.05$). A correlation was also measured among variables (Haro and Barreras, 2005).

RESULTS AND DISCUSSION

Toxocara contamination soils park's was not different with a mean of 24.68% (Table 1) which is more reduced than the observed in Mexico City (60%; Romero *et al*., 2009) and other Latin American countries such as Peru (70.6%), Brazil 68.0% (Shimizu, 1993) and Chile 68.18% (Fonrouge *et al*., 2000) and Venezuela 60% (Cazoria *et al*., 2007). But is higher than the observed in other European countries like Spain 9% (Ruiz *et al*., 2001) and Ireland 6% (O'Lorcain, 1994). The toxocariasis tends to me more frequent in tropical climates than in temperate ones and also in rural populations in the same regions or countries. The viability of the samples in Tejupilco was not different among parks with a mean of 60.88% (Table 1). Even when

Table 1: Contamination by *Toxocara* sp. eggs in soil of parks and home gardens

Parks	Positive (%)	Viable (%)	No. eggs g^{-1}	No. larva g^{-1}
Soil of parks				
Park 1	25.00[a]	62.50[a]	5.12[ab]	3.95[a]
Park 2	30.00[a]	69.33[a]	6.23[a]	4.51[a]
Park 3	17.22[a]	44.71[a]	5.55[ab]	4.25[a]
Park 4	26.50[a]	67.00[a]	3.93[b]	2.60[a]
Coefficient of variation (%)	56.58	71.58	66.74	109.46
Soil in home gardens				
Park 1	8.00[b]	40.00[a]	3.00[a]	1.25[a]
Park 2	32.00[a]	52.86[a]	4.00[a]	1.21[a]
Park 3	20.00[ab]	44.00[a]	3.90[a]	2.90[a]
Park 4	18.00[ab]	60.00[a]	2.70[a]	2.00[a]
Coefficient of variation (%)	75.28	86.79	58.17	140.20

[a, b]Means with no common superscript in a row differ at $p<0.05$

there is scarce information on viability of the eggs from the soil, experimental infestation of rats showed a viability of 23% (Sommerrfelt *et al*., 2002). However, It has also reported a high environmental contamination of Toxocara eggs in countries with temperate climates such as Germany (Duwell, 1984) or Japan (Shimizu, 1993) were most of eggs (51-95%) collected in soil were embryonated which represents a high risk of contaminations for humans and other hosts (Rubinsky-Elefant *et al*., 2010).

There were some differences in the number of eggs per gram of soil sample among parks ($p<0.05$) with a range from 3.93-6.23 and a mean of 5.2 however, there was no difference in the number of larvae by the origin of park with a mean a 3.82 which represents a 73.4% viability of the eggs T (Table 1). Fonrouge *et al*. (2000) reported in soil samples a mean of 1.43 eggs g^{-1}, a mode of 1.0 with a range from 1-4. Viability in this study is lower to the 90% reported by Vazquez *et al*. (1996) in eggs which were larvaeted collected in public parks and home gardens from Mexico city.

There was a more variation in the contamination frequency by *Toxocara* sp. eggs in home gardens than in public parks with a mean of 19.5% without differences among sites (Table 1). The contamination is similar to the reported by Vazquez *et al*. (1996) of 16.7%. Even when the contamination is lower than the parks, the risks for transmission for children are still present considering that the viability was high in the entire gardens sampled mean (49.21%). The frequency of contamination is similar to the observed in public gardens of San Cristobal de las Casas in Chiapas (40%) by Barbosa. The number of toxocara eggs in home gardens was slightly minor than the observed in parks (mean 3.41) and by the consequence less larvae (mean 1.84; Table 1) which shows a reduced viability (53.84%) compared to the reported by Vazquez *et al*. (1996) in home gardens (90%). There are several factors which affect the contamination level of the soil in which the control of dog feces appears

Table 2: Frequency of *Toxocara* sp. in feces collected from public streets and dogs with owner dogs in Tejupilco at the subhumid tropic of Mexico

Parks	Positive (%)	Viable (%)	No. eggs g^{-1}	No. larva g^{-1}
Soil of parks				
Park 1	20.00[a]	78.57[a]	7.04[ab]	4.19[b]
Park 2	23.33[a]	100.00[a]	9.57[a]	9.57[a]
Park 3	20.00[a]	44.00[a]	3.90[bc]	2.90[b]
Park 4	18.00[a]	60.00[a]	2.77[c]	2.00[b]
Coefficient of variation (%)	44.72	57.08	60.06	96.04
Dogs with owners				
Park 1	38.88[a]	93.75[a]	6.94[a]	6.40[a]
Park 2	30.00[a]	100.00[a]	9.12[a]	7.25[a]
Park 3	30.00[a]	100.00[a]	7.00[a]	7.00[a]
Park 4	38.00[a]	81.25[a]	6.50[a]	4.55[a]
Coefficient of variation (%)	35.59	17.48	60.71	74.01

[a, b]Means with no common superscript in a row differ at $p<0.05$

to be the main factor and others have some influence like the frequency of dogs desparasitation (Habluetzel *et al*., 2003) and climatic conditions (Cazoria *et al*., 2007).

The contamination of *T. canis* eggs the streets surrounding the parks of Tejupilco was not different among parks (20.33%; Table 2) and is similar to the reported in Chiapas (19%) by Barbosa who also observed higher contamination in highways where there was no routinely removal of feces (42.8%). The viability of those eggs was similar among sites (Table 2) and relatively low (mean 20.33%). The number of eggs was different among sites ($p<0.05$) with a range from 2.77-9.57 and a mean of 5.82 (Table 2) which indicate that the dogs frequently defecate in the streets which results in a high number of larvae (mean 4.66; Table 2) highly viable (80.15%). Most of the studies have been conducted in parks (Shimizu, 1993; Fonrouge *et al*., 2000; Cazoria *et al*., 2007; Romero *et al*., 2009), however this results and those from Barbosa indicate that streets are also a potential source of dispersion of the parasite particularly in countries where there is no control of dogs without owners and where removal of dog feces is not adequate.

No differences were found in dogs sampled in the parks. A total of 34.22% of dogs were positive to Toxocara with 93.4% of samples viable (Table 2). The infestation is lower than reported in other studies in Mexico city 63.36% (Romero *et al*., 2009) and similar to that reported in Italy (33.6%) which included rural and urban dogs were the rural had almost the double of contamination than the city dogs (Habluetzel *et al*., 2003).

As expected, the number samples from dogs were high in eggs (mean 7.39) and larvae (mean 6.30) without differences among sites (Table 2), representing eggs highly viabile (85.25%). Schantz and Steher-Green (1988) have estimated that a female dog may excrete up to 200,000 eggs day^{-1} and their infested puppet up to 15,000 eggs of Toxocara (Kerr-Muir, 1994). There is no information about street dogs but their importance in the dissemination of the parasite needs to be elucidated. It has been recognized that dogs as a pets are potential factors for Toxocara infestation (Jarosz *et al*., 2010) however, the parasite can be acquired without having company animals which is predisposed by street dogs that disseminate infective eggs. The role of other pets like acts, needs to be elucidated as a source of toxocara contamination (Rubinsky-Elefant *et al*., 2010).

The contamination among sites were not correlated, only the number of eggs with the viable larvae ($r = 0.97$, $p<0.02$). Other researchers have not been able to demonstrate this statistical correlation (Romero *et al*., 2009) but that does not mean that it is important to recognize the importance of the dog in the dissemination of this parasite and to promote other hygienic measures such as washing hands in children particularly after playing in gardens or parks (Laird *et al*., 2000). Unfortunately, since this zoonotic diseases have low impact in public heath receive little attention in many countries (Polo *et al*., 2007).

CONCLUSION

The dogs as well as the soils in parks, home gardens and streets sampled in Tejupilco, State of Mexico are a potential source of Toxocara eggs infestation which disseminates the parasite in dogs and presumably in humans. It is important to maintain veterinary assistance for pet desparasitation (dogs and cats) and to reduce fecal material in the areas as well as the control of paratenic hosts and other sources of contamination to reduce the environmental pollution of this parasite and this zoonotical disease.

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