

# Occurrence of antibodies to *Toxoplasma gondii* in opossums caught in urban areas of Bauru, state of São Paulo, Brazil

## *Ocorrência de anticorpos para Toxoplasma gondii em gambás capturados na área urbana de Bauru, Estado de São Paulo, Brasil*

Simone Baldini LUCHEIS<sup>1,2,3</sup>; Daniela Barbosa DA SILVA<sup>3</sup>; Lívia Maísa GUIRALDI<sup>2</sup>; Wesley José SANTOS<sup>2</sup>; Mirian Dos Santos PAIXÃO<sup>2</sup>; Maria Fernanda ALVES-MARTIN<sup>2</sup>; Fabio Almeida LEMOS<sup>3</sup>; Gabriela Pacheco SÁNCHEZ<sup>3</sup>; Maria Emília Bodini SANTIAGO<sup>4</sup>

<sup>1</sup> Agência Paulista de Tecnologia dos Agronegócios (APTA/SAA), Polo Centro-Oeste, Laboratório de Sanidade Animal, Bauru - SP, Brazil

<sup>2</sup> Universidade Estadual Paulista "Júlio de Mesquita Filho", Faculdade de Medicina, Departamento de Doenças Tropicais, Botucatu - SP, Brazil

<sup>3</sup> Universidade Estadual Paulista "Júlio de Mesquita Filho", Faculdade de Medicina Veterinária, Departamento de Higiene Veterinária e Saúde Pública, Botucatu - SP, Brazil

<sup>4</sup> Zoológico Municipal de Bauru, Bauru - SP, Brazil

---

### Abstract

Toxoplasmosis is one of the most common zoonoses worldwide. It was initially described in rodents and rabbits. There are few data on the morbidity and mortality of this disease among Brazilian marsupial fauna, such as opossums. These animals are of great importance regarding the epidemiology of this disease, given that they are prey for felids and other carnivores. With the aim of ascertaining the serological response to *Toxoplasma gondii* among marsupials (*Didelphis* spp.), 38 animals that had been caught in 14 districts of the urban area of the municipality of Bauru, state of São Paulo, were evaluated. The modified agglutination test (MAT) showed that 26.3% (10/38) of the samples analyzed were seropositive. It can be suggested that the opossums' behavior and persistent proximity to human housing results in contact with cats and *T. gondii* infection, based on the frequency found in this study. This was the first study on the seroprevalence of *T. gondii* in opossums caught in the urban area of the municipality of Bauru, SP, and it highlights the need for environmental and health authorities of the municipality to monitor this zoonosis.

**Keywords:** *Didelphis*. Toxoplasmosis. Zoonosis. *T. gondii*.

---

### Resumo

A toxoplasmose é uma das zoonoses mais comuns no mundo, tendo sido descrita inicialmente em roedores e em coelhos. Todavia, poucos são os dados sobre morbidade e mortalidade da toxoplasmose nos marsupiais da fauna brasileira, como os gambás, sendo de grande importância na epidemiologia da doença, como presas para felídeos e outros carnívoros. Com o objetivo de verificar a resposta sorológica para *Toxoplasma gondii* em marsupiais (*Didelphis* spp.), foram avaliados 38 animais capturados em 14 regiões da área urbana do município de Bauru-SP. Foi encontrada uma frequência, de acordo com o teste de aglutinação modificada (MAT), de 26,3% (10/38) nas amostras analisadas. Pode-se sugerir que o comportamento dos gambás e sua permanência próxima a habitações humanas resultam em contato com gatos e infecção por *T. gondii*, tendo em vista a frequência encontrada neste estudo. Este é o primeiro estudo de soroprevalência de *T. gondii* em gambás capturados na área urbana do município de Bauru-SP, alertando-se para a necessidade do monitoramento desta zoonose pelas autoridades de vigilância ambiental e sanitária do município.

**Palavras-chave:** *Didelphis*. Toxoplasmose. Zoonoses. *T. gondii*.

---

**Correspondence to:**

Simone Baldini Lucheis  
 Agência Paulista de Tecnologia dos Agronegócios – APTA  
 Centro-Oeste  
 Av. Rodrigues Alves, 40-40  
 CEP 17030-000, Bauru, SP, Brazil  
 e-mail: silucheis@yahoo.com.br; silucheis@apta.sp.gov.br

Received: 23/12/2015

Approved: 01/12/2016

Among zoonotic diseases, one of the most common examples is toxoplasmosis. The life cycle of the parasite involved (*Toxoplasma gondii*) alternates between the intermediate host (mammals or birds) of the asexual stages and the definitive host (felines) (TENTER; JOHNSON, 1997). However, information about morbidity and mortality due to this disease among Brazilian marsupials (*Didelphis* spp.) is not available, and marsupials in the Americas are considered resistant to clinical toxoplasmosis (CANFIELD et al., 1990). Antibodies to *T. gondii* were found in marsupials from different Brazilian regions (YAI et al., 2008; FORNAZARI et al., 2011; SIQUEIRA et al., 2013; GENNARI et al., 2015).

Opossums belong to the order Marsupialia. They are omnivorous mammals with nocturnal habits and are widely distributed in South America. Because of their opportunistic behavior, these animals are well adapted to several environments. Opossums can live in rural and urban areas, and are more commonly found in the latter because of the availability of water, food and shelter. This characteristic makes them important disseminators of diseases to domestic and wild animals, and to humans (MULLER et al., 2005).

The objective of the present study was to determine the presence of antibodies to *T. gondii* in opossums from urban areas of the municipality of Bauru, São Paulo State, Brazil.

In the present study, 38 opossums of different species of *Didelphis* spp., which had been caught in 14 different areas of the municipality of Bauru, were evaluated. There were 28 females (including their joeys of several ages) and 10 males.

The animals were caught using mesh nets and were then immobilized by means of direct intramuscular injection of ketamine (7 mg/kg) or using anesthetic darts. The blood samples were collected by means of jugular venipuncture, using disposable needles (40 x 12 for larger animals or 25 x 7 for smaller animals).

The samples were collected in microtubes, identified and sent to the Animal Health Laboratory at the São Paulo Agribusiness Technology Agency (APTA), in Bauru, for serological testing.

Presence of anti-*T. gondii* antibodies was investigated using the modified agglutination test (MAT). Antigen production and fixation using formalin were performed as described by Desmonts and Remington (1980), using a cutoff of 16 (BRAGA et al., 2014; CARNEIRO et al., 2014).

Among the opossums sampled, 26.3% (10/38) were seropositive for *T. gondii*. Of these, 60% (6/10) presented titers of 16, 20% (2/10) presented titers of 64 and 20% (2/10) presented titers of 256. The numbers of animals caught, according to locality and serological response to *T. gondii*, are shown in Table 1.

The municipality of Bauru has several deforested areas and is in a typical *cerrado* region. The constant changes to the urban landscape of the city have led to the appearance of wild species in these environments, such as opossums (*Didelphis* spp.). Several reports in the national and international literature, using different diagnostic methods, such as serological, molecular and bioassay techniques, have demonstrated the involvement of opossums in toxoplasmosis in different geographical regions (FERRARONI; MARZOCHI, 1980; YAI et al., 2008; FORNAZARI et al., 2011; SIQUEIRA, 2013; FOURNIER et al., 2014). This is the first study on the seroprevalence of *T. gondii* among opossums caught in the urban area of the municipality of Bauru, SP, and it highlights the need for environmental and health authorities of the municipality to monitor this zoonosis.

Based on these results, we conclude that the reality of ecological imbalance, with proximity of marsupials to housing and their surroundings, demonstrates that

there is a need for extensive epidemiological surveillance in relation to toxoplasmosis, both in natural and urban areas of the municipality.

The use of captured animals was approved by the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), under protocol #113/2005. The project was conducted in accordance

with the Ethical Principles for Animal Research issued by the Brazilian College of Animal Experimentation.

### Acknowledgements

The researchers would like to thank IBAMA and the 12<sup>th</sup> Group of Bauru's Fire Brigade.

Table 1 – Frequency of seropositivity for *T. gondii* among specimens of *Didelphis* spp. using the modified agglutination test (MAT), and the respective titers, by captured localities in the municipality of Bauru, state of São Paulo – Brazil – 2016

Localities	Number of animals	Number of positive	% of positive	Titers		
				16	64	256
Vila Vergueiro	2	1	50	-	-	1
Jardim Botânico	1	1	100	1	-	-
Núcleo Habitacional Mary Dota	6	2	28.6	1	1	-
Jardim Colonial	1	1	100	1	-	-
CEASA (Jardim Colonial)	6	2	33.3	2	-	-
Vila Vicentina	4	2	50	1	-	1
Vila São João da Boa Vista	3	1	33.3	-	1	-
Vila Cardia	4	0	0	-	-	-
Vila Contorno	1	0	0	-	-	-
Vila Antártica	1	0	0	-	-	-
Vargem Limpa	3	0	0	-	-	-
Aviação	2	0	0	-	-	-
Jardim Brasil	1	0	0	-	-	-
Center	3	0	0	-	-	-
<b>Total</b>	<b>38</b>	<b>10</b>	<b>26.3</b>	<b>6</b>	<b>2</b>	<b>2</b>

Legend: - = absence of antibodies against *Toxoplasma gondii*

Among the 10 positive animals, nine were female and only one was male

## References

- BRAGA, A. R. C.; CORRÊA, A. P.; CAMOSSI, L. G.; SILVA, R. C.; LANGONI, H.; LUCHEIS, S. B. Coinfection by *Toxoplasma gondii* and *Leishmania* spp. in domestic cats (*Felis catus*) in State of Mato Grosso do Sul. **Revista da Sociedade Brasileira de Medicina Tropical**, v. 47, n. 6, p. 796-797, 2014. doi: 10.1590/0037-8682-0041-2014.
- CANFIELD, P. J.; HARTLEY, W. J.; DUBEY, J. P. Lesions of toxoplasmosis in Australian marsupials. **Journal of Comparative Pathology**, v. 103, n. 2, p. 159-167, 1990. doi: 10.1016/S0021-9975(08)80172-7.
- CARNEIRO, B. F.; MIRANDA, M. M.; SILVEIRA NETO, O. J.; LINHARES, G. F. C.; ARAÚJO, L. B. M. Inquérito sorológico para *toxoplasma gondii* em mamíferos neotropicais mantidos no centro de triagem de animais silvestres, Goiânia, Goiás. **Revista de Patologia Tropical**, v. 43, n. 1, p. 69-78, 2014. doi: 10.5216/rpt.v43i1.29373.
- DESMONTS, G.; REMINGTON, J. S. Direct agglutination test for diagnosis of *Toxoplasma* infection: method for increasing sensitivity and specificity. **Journal of Clinical Microbiology**, v. 11, n. 6, p. 562-568, 1980. Available from: <<http://jcm.asm.org/content/11/6/562.short>>. Viewed: 21 Dec. 2015.
- FERRARONI, J. J.; MARZOCHI, M. C. A. Prevalência da infecção do *Toxoplasma gondii* em animais domésticos, silvestres e agrupamentos humanos na Amazônia. **Memória do Instituto Oswaldo Cruz**, v. 75, n. 1-2, p. 99-109, 1980. doi: 10.1590/S0074-02761980000100010.
- FORNAZARI, F.; TEIXEIRA, C. R.; SILVA, R. M.; LEIVA, M.; ALMEIDA, S. C.; LANGONI, H. Prevalence of antibodies against *Toxoplasma gondii* among Brazilian white-eared opossums (*Didelphis albiventris*). **Veterinary Parasitology**, v. 179, n. 1-3, p. 238-41, 2011. doi: 10.1016/j.vetpar.2011.02.005.
- FOURNIER, G. F. S. R.; LOPES, M. G.; MARCILI, A.; RAMIREZ, D. G.; ACOSTA, I. C.; FERREIRA, J. I. G. S.; CABRAL, A. D.; LIMA, J. T. R.; PENA, H. F.; DIAS, R. A.; GENNARI, S. M. *Toxoplasma gondii* in domestic and wild animals from forest fragments of the municipality of Natal, northeastern Brazil. **Revista Brasileira de Parasitologia Veterinária**, v. 23, n. 4, p. 501-508, 2014. doi: 10.1590/S1984-29612014092.
- GENNARI, S. M.; OGRZEWALSKA, M. H.; SOARES, H. S.; SARAIVA, D. G.; PINTER, A.; NIERI-BASTOS, F. A.; LABRUNA, M. B.; SZABÓ, M. P. J.; DUBEY, J. P. *Toxoplasma gondii* antibodies in wild rodents and marsupials from the Atlantic Forest, state of São Paulo, Brazil. **Revista Brasileira de Parasitologia Veterinária**, v. 24, n. 3, p. 379-382, 2015. doi: 10.1590/S1984-29612015045.
- MULLER, G.; BRUM, J. G. W.; LANGONI, P. Q.; MICHELS, G. H.; SINKOC, A. L.; RUAS, J. L.; BERNE, M. E. A. *Didelphis albiventris* (Lund 1841), parasitado por *Ixodes loricatus* (Neumann, 1899) e *Amblyoma aureolatum* (Pallas, 1772) (*Acari Ixodidae*) no Rio Grande do Sul. **Arquivos do Instituto Biológico**, v. 72, n. 3, p. 319-324, 2005. Available from: <<https://goo.gl/FIeqV>>. Viewed: 21 Dec. 2015.
- SIQUEIRA, D. B.; ALÉSSIO, F. M.; MAUFFREY, J. F.; MARVULO, M. F. V.; RIBEIRO, V. O.; OLIVEIRA, R. L.; PENA, H. F. J.; GENNARI, S. M.; MOTA, R. A.; FAUSTINO, M. A. G.; ALVES, L. C.; DUBEY, J. P.; SILVA, J. C. R. Seroprevalence of *Toxoplasma gondii* in wild marsupials and rodents from the Atlantic forest of Pernambuco State, northeastern region, Brazil. **Journal of Parasitology**, v. 99, n. 6, p. 1140-1143, 2013. doi: 10.1645/GE-2855.1.
- TENTER, A. M.; JOHNSON, A. M. Phylogeny of the tissue cyst-forming coccidian. **Advances in Parasitology**, v. 39, p. 69-139, 1997. doi: 10.1016/S0065-308X(08)60045-7.
- YAI, L. E. O.; RAGOZO, A. M. A.; AGUIAR, D. M.; DAMACENO, J. T.; OLIVEIRA, L. N.; DUBEY, J. P.; GENNARI, S. M. Isolation of *Toxoplasma gondii* from capybaras (*Hydrochaeris hydrochaeris*) from São Paulo State, Brazil. **Journal of Parasitology**, v. 94, n. 5, p. 1060-1063, 2008. doi: 10.1645/GE-1548.1.