

## INFECTION BY *Trypanosoma cruzi* IN MAMMALS IN YUCATAN, MEXICO: A SEROLOGICAL AND PARASITOLOGICAL STUDY

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### SUMMARY

In order to determine *Trypanosoma cruzi* infection among mammals in Yucatan, Mexico, 372 animals, both wild and synanthropic including carnivores, marsupials and rodents were studied.

Serological studies by indirect haemagglutination (IHA) were carried out to detect antibodies to *T. cruzi* and a parasitological study was also performed (blood smear and histopathology).

Of all the animals tested 18.54% were serologically positive, with a significantly higher frequency among the wild ones (33.33%) compared to the synanthropic ones (17.79%).

To determine *T. cruzi* in positive animals, blood was inoculated into a white mouse (webster type) to prove myocardium colonization.

The serological and parasitological positivity of these animals, as well as their behavior in the environment, taken together with the socioeconomic and cultural characteristics of the population, suggest that in Yucatan, Mexico, *Canis familiaris*, *Didelphis marsupialis* and *Rattus rattus* act as a link with the wild cycle.

**KEYWORDS:** *T. cruzi*; Mammals; Zoonosis.

### INTRODUCTION

The first human cases of Chagas' disease in Mexico were recorded in 1940<sup>13</sup>. Some years later animals naturally infected with *Trypanosoma cruzi*, specifically *Didelphis marsupialis*, *Dasyfus novemcinctus*, *Rattus rattus* and *Canis familiaris*, were found<sup>3,5,14</sup>. Since then, few studies have been carried out in this country on the carriers which take part in the maintenance of the domestic and wild cycles of the parasite in the different endemic regions of Mexico<sup>4,8,15,18</sup>. All of these studies were conducted in regions between 0 and 1800 meters above sea level, due to the fact that triatomine bugs infected with *T. cruzi* were found at those altitudes. These regions comprise more than two thirds of Mexico and display wide ecological variety.

With the aim of expanding knowledge about *T. cruzi* carriers, this study was carried out from March 1990 to April 1991, in Yucatan state, where the existence of the parasite was demonstrated in 1937<sup>12</sup>. Subsequently, since 1974, this has been considered an important endemic area when reactivity was found in humans (11.2%), as well as a considerable frequency of infection among triatomine bugs (16%) and human cases, both in the acute and chronic stages<sup>2,9</sup>.

### MATERIALS AND METHODS

#### Area of study

Yucatan state is located in the extreme north of the Yucatan Peninsula, south-east Mexico. It is situated between 19°29' and 21°37' latitude north and 87°32' and

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90°25' longitude west, at an altitude of 0 to 45 meters above sea level. Its climate is hot and humid with an average temperature of 26°, relative humidity of 72% and its annual rainfall varies between 415 and 1290 mm. It covers an area of 43,379 km<sup>2</sup> with 378 km of coastline. It is divided into 106 municipalities with a total of 218,990 dwellings. In 1989, the total population of Yucatan state was 1,363,540 distributed among 247,916 families<sup>7</sup>.

Using two stage cluster sampling (K N/n), eight municipalities were chosen in Yucatan state, and in seven of them two localities were chosen. In the municipality in which the state capital is located, ten localities were chosen. Five dwellings were chosen at each locality. The synanthropic animals were captured inside and around the houses within a radius of 100 m<sup>17</sup>. The wild animals were captured in wild areas surrounding each locality chosen.

#### Trapping of the animals

The synanthropic animals were divided into two groups: domesticated (those which are controlled by man) and undomesticated. From the domesticated synanthropics, blood was taken by venipuncture for the detection of *T. cruzi* by direct observation of blood smears stained with May Grunwald dye. Serum was also used to detect antibodies to *T. cruzi* by the indirect haemagglutination method (Cellognost-Chagas. Behring Institute), considering as a positive test titres  $\geq 1:16$  according to the manufacturer.

The undomesticated synanthropics and the wild animals were captured using Tomahawk and Sherman traps. From each captured animal, previously anaesthetized with sulphuric ether, blood was obtained by cardiac puncture to detect *T. cruzi* by direct observation; and antibodies to *T. cruzi* were also detected as described above. The animals were sacrificed with excess ether and autopsy was performed to obtain heart, liver, spleen, esophagus, colon and gastrocnemius muscle, in order to detect intracellular parasites in tissue fragments embedded in paraffin, cut into 5  $\mu$ m thick sections and stained with haematoxylin-eosin.

To determine *T. cruzi* in the positive animals, blood was inoculated into a white mouse (webster type) to prove myocardium colonization.

## RESULTS

A total of 372 animals were captured and of these 197 (52.95%) were domesticated synanthropics, 151 (40.59%) were undomesticated synanthropics and 18 (4.83%) were wild animals. The animals captured belonged to the following order, family, genus and species.

Order Carnivora, families Canidae, *Canis familiaris* (183 = 49.19%), *Urocyon cinereoargenteus* (6 = 1.61%), Felidae *Felis catus* (14 = 3.76%) and Mustelidae *Spilogale putorius* (2 = 0.53%). Order Marsupialia, family Didelphidae *Didelphis marsupialis tabascensis* (110 = 29.56%). Order Rodentia, families Dasyproctidae *Dasyprocta punctata yucatanicus* (1 = 0.26%), Heteromyiinae *Heteromys gaumeri* (1 = 0.26%), Geomyidae *Orthogeomys hispidus yucatanensis* (1 = 0.26%), Muridae *Mus musculus* (24 = 6.45%), *Rattus rattus* (17 = 4.56%), *Peromyscus leucopus* (2 = 0.53%), *Peromyscus yucatanicus* (9 = 2.41%) and *Otodylomys phyllotis* (1 = 0.26%), and the order Lagomorpha, family Leporidae *Sylvilagus floridanus* (1 = 0.26%).

## SEROLOGY

Of the 372 serum samples studied, 69 (18.54%) showed serological reactivity to *T. cruzi*. The following prevalences were found: domesticated synanthropics: 15.73%, undomesticated synanthropics: 19.86%, and wild: 33.33% (Table 1); statistical analysis of the serological data assembled in a contingency table, showed no significant difference between the two synanthropic groups (P = 0.84). Because of the very small number of wild animals studied, it was not possible to perform a comparative statistical analysis.

In the species analysis, *Canis familiaris* presented the highest serological prevalence among the domestic synanthropic animals and *Rattus rattus* among the nondomestic group. Serological positivity was found in only four of the wild species studied (Table 2).

## PARASITOLOGY

Among the species studied *Didelphis marsupialis* (15.45%) and *Rattus rattus* (29.41%), undomesticated synanthropic species, were found to be positive.

## DISCUSSION

The fact that this zoonosis has survived in nature as a wild enzootic disease is reflected on the serological positivity to *T. cruzi* that was found in the wild animals, when compared to the domesticated and undomesticated synanthropics. Only four of the nine species captured (*Peromyscus leucopus*, *Peromyscus yucatanicus*, *Dasyprocta punctata* and *Urocyon cinereoargenteus*), were serologically positive to *T. cruzi*. These genera were considered to be wild carriers of American Trypanosomiasis<sup>20</sup>. The species of *Peromyscus* which were found to be positive to *T. cruzi* are distributed as follows: *P. leucopus* can be found from the north of the United States of America to the south of the Mexican Republic and *P. yucatanicus* can only be found in the

**TABLE 1**  
Serological response to *Trypanosoma cruzi* in the three groups of mammals studied.

Group	N	Positive animals	%
Domesticated Synanthropics (DS)	197	31	15.73
Undomesticated Synanthropics (US)	151	30	19.86
Wild	24	8	33.33

Comparison DS vs US:  $X^2 = 0.84$ ,  $P = 0.5 > 0.25$ .

Yucatan Peninsula<sup>10</sup>. These species had not been previously identified as carriers of *T. cruzi*.

In different endemic areas of American Trypanosomiasis, a higher prevalence of reactivity to *T. cruzi* has usually been observed in the synanthropic reservoir than in humans<sup>21</sup>. In our study, that was not shown to be the case, since the serological frequency observed in humans (15.62%) in the same geographical area was practically the same (18.39%) as that observed in the synanthropic reservoir. All the species captured in the dwellings and/or their out-houses seem to participate as carriers and

therefore are involved in the maintenance of this parasitosis in its predomiciliary and/or domiciliary cycle. However, *Canis familiaris* (dog), *Didelphis marsupialis t.* (opossum) and *Rattus rattus* (rat) by being animals which share rural and urban habitats: (the dog accompanying man in his farm work and then staying inside the house; the opossum building its nest in the out-houses; the rat establishing its nest inside and outside the houses), could all be the main carriers in the domiciliary cycle in Yucatan, Mexico. The serological reactivity observed in each of these species of domesticated and undomesticated synanthropic animals was almost identical. This could be due to the fact that in our environment there is only one genus and species of triatomine bug, *Triatoma dimidiata*, which usually belongs to a wild habitat but also colonizes houses<sup>9</sup>. No great difference was found in this type of carrier with respect to positive infection by *T. cruzi* compared to the data reported in other studies carried out on the American Continent<sup>11,19,22</sup>.

The fact that *Didelphis marsupialis t.* and *Rattus rattus* were the only undomesticated synanthropic and wild animals found to be positive in the parasitological study supports our idea of the essential role that they play in the maintenance of the domiciliary cycle of the parasite and its link with the wild one.

**TABLE 2**  
Serological reactivity to *Trypanosoma cruzi* of the species studied.

Species	N	Positive animals	%
<b>DOMESTICATED SYNANTHROPICS</b>			
<i>Canis familiaris</i>	183	29	15.84
<i>Felis catus</i>	14	2	14.28
<b>UNDOMESTICATED SYNANTHROPICS</b>			
<i>Didelphis marsupialis</i>	110	13	11.81
<i>Rattus rattus</i>	17	8	47.05
<i>Mus musculus</i>	24	9	37.50
<b>WILD</b>			
<i>Peromyscus leucopus</i>	2	1	50.00
<i>P. yucatanicus</i>	9	2	22.22
<i>Dasyprocta punctata</i>	1	1	100
<i>Urocyon cinereoargenteus</i>	6	4	66.66
<i>Spilogale putorius</i>	2	0	0.00
<i>Orthogeomys hispidus</i>	1	0	0.00
<i>Heteromys gaumeri</i>	1	0	0.00
<i>Oryzomys phyllotis</i>	1	0	0.00
<i>Sylvilagus floridanus</i>	1	0	0.00
<b>TOTAL</b>	<b>372</b>	<b>69</b>	<b>18.54</b>

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## RESUMO

### Infecção pelo *Trypanosoma cruzi* em mamíferos em Yucatan, México: estudo sorológico e parasitológico

Para determinar a infecção pelo *Trypanosoma cruzi* em mamíferos em Yucatan, México, foram estudados 372 animais selvagens e sinantrópicos incluindo carnívoros, marsupiais e roedores.

Estudos sorológicos pela hemaglutinação indireta (IHA) foram realizados para detectar anticorpos contra o *T. cruzi* e estudos parasitológicos (esfregaços de sangue e histopatologia).

De todos os animais testados 18,54% foram sorologicamente positivos com frequência significativamente maior entre os silvestres (33,3%) em comparação com os sinantrópicos (11,79%).

Para determinação do *T. cruzi* nos animais positivos, o sangue foi inoculado em camundongos brancos (tipo Webster) para provar a colonização miocárdica.

Através da sua positividade sorológica e parasitológica, bem como seu comportamento no meio ambiente acompanhado pelas características sociais, econômicas e culturais da população, deduz-se que em Yucatan, México, *Canis familiaris*, *Didelphis marsupialis* e *Rattus rattus* atuam como ligação com o ciclo selvagem.

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