RESEARCH NOTE

The Synanthropic Process of Chagas Disease Vectors in Brazil, with Special Attention to *Triatoma brasiliensis* Neiva, 1911 (Hemiptera, Reduviidae, Triatominae) Population, Genetical, Ecological, and Epidemiological Aspects

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Key words: Chagas disease - Triatominae

Until 1983, 36% of the Brazilian territory was considered endemic, or at risk, for Chagas disease and more than 50% of all Brazilian municipalities presented domiciliary triatomine infestation. In 20 years, Chagas disease transmission decreased dramatically. The number of municipalities infested by *Triatoma infestans* (Klug, 1834) was reduced from 30.4% in 1983 to 7.6% in 1993 (AC Silveira & DF Rezende 1994 *Rev Bras Med Trop 27*: 11-22).

Ecological succession observed by the replacement of one species for another have resulted from control programs and from drastic environmental changes. Data from the Chagas Disease Control Program in Minas Gerais, for the period 1979-1989, show that *Triatoma sordida* (Stal, 1859) predominated the last years over *T. infestans* which was previously the main domiciliary vector. This fact was largely attributed to the control actions which had eliminated *T. infestans* from the domiciliary units (L Diotaiuti et al. 1995 *Bol Oficina Sanit Panam 118*: 211-219). The same was observed for *Triatoma rubrovaria* (Blanchard, 1843) and *T. infestans* in Rio Grande do Sul for the period 1980-1998 (Fundação Nacional de Saúde).

Triatomine species were clustered in categories according to their vectorial potentiality, with consequences applied to objectives and strategies of control programs. It was reported that *T. rubrovaria* and *Rhodnius neglectus* Lent, 1954, both found naturally infected by *Trypanosoma cruzi*, occupied empty niches following the elimination of *T. infestans*, in Rio Grande do Sul and some areas of Goiás, respectively. *Rhodnius nasutus* Stal, 1859 presents a focal importance in the transmission of disease in Ceará and particularly in Rio Grande do Norte, in spite of a low rate of *T. cruzi* natural infection. *Triatoma vitticeps* (Stal, 1859) has a geographical distribution restricted to Rio de Janeiro, Espírito Santo and Minas Gerais. Nevertheless, this species presents one of the highest rate of natural infection and is able to invade domiciles. *Panstrongylus megistus* (Burmeister, 1835) and *Triatoma brasiliensis* Neiva, 1911, classified as "native" species, cannot be erradicated by a continuing and regular chemical control because treated houses may be reinfested from wild foci. *T. infestans* and *Triatoma rubrofasciata* (De Geer, 1773) which are considered as "introduced" species and strictly domiciliated in Brazil, can be eliminated without the possibility of reinfestation from extradomiciliary foci. However, *T. infestans* and *T. rubrofasciata* have distinct epidemiological importance. *T. infestans* presents a marked anthropophily and was considered the most important Chagas disease vector while *T. rubrofasciata* prefers domestic rodent as blood source (Silveira & Rezende 1994 *loc. cit.*).

Recently, *P. megistus* was found in artificial ecotopes in Florianópolis, Santa Catarina, southern Brazil. *T. cruzi* infection rate of the analyzed specimens was 53.3% and a similar rate was obtained from wild specimens. Precipitin tests revealed that 94% of the insects fed on only one blood source. The gut content of 80.6% adult insects reacted for human blood. It must be stressed that this species was reported in domiciliated condition only in northeastern and southeastern Brazil (M Steindel et al. 1994 *Rev. Inst Med trop S Paulo 36*: 43-50).

It is also important to mention the existence of species formerly considered as strictly wild but which have been having more and more contact with human hosts, changing therefore their epidemiological characteristics. *Rhodnius brethesi* Matta, 1919, for instance, which occurs among the piassaba palm trees (*Leopoldinia piassaba* Walace) and feed on wild animals that live in these ecotopes,

Supported by CNPq and FNS.
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Received 9 June 1999
Accepted 9 August 1999

has been reported attacking humans working on piassaba collection (H Lent & P Wygodzinsky 1979 *Bull Amer Mus Natur Hist 163*: 123-520). Recently, in the Amazon Region, a group of *R. brethesi* were seen performing an "air raid" to voraciously feed on humans workers collecting piassaba in the forest (JR Coura et al. 1994 *Rev Soc Bras Med Trop 27*: 251-253).

Another approach on the Chagas disease dissemination on the Amazon was carried out by SAE Valente & VC Valente (1993 *Rev Soc Bras Med Trop 26*: 68-70). These authors emphasize the high levels of natural infection of the reservoirs and wild vectors, even in the Belém municipality (Pará). Some wild vector species as a result of reduction of its natural food source can invade domiciles and the peridomiciles. In Muaná, Pará, almost 100 specimens of *Panstrongylus geniculatus* (Lattreille, 1811), presenting 25% of natural infection, were found in peridomiciliar area associated with domestic pigs, and also feeding on humans.

After *T. infestans* population control was achieved, *T. brasiliensis* became one of the priorities of the Brazilian Ministry of Health. *T. brasiliensis* is now considered to be the main Chagas disease vector on semiarid zones of northeastern Brazil.

The genetic-ecological characteristics of *T. brasiliensis* lead this species to occupy natural as artificial ecotopes. It takes place therefore actively in the *T. cruzi* wild cycle, being able to transport the parasite from wild foci to artificial ecotopes, allowing the infestation and reinfestation of human dwellings (MP Barretto 1976 *Rev Soc Bras Med Trop 10*: 339-353).

Multidisciplinary studies showed that *T. brasiliensis* is constituted by, at least, four geographical populations: brasiliensis, melanica, macromelasoma and juazeiro. These populations can be differentiated by their morphology (J Costa et al. 1997 *Mem Inst Oswaldo Cruz 92*: 463-498), biology (J Costa & V Marchon-Silva 1998 *Entomologia & Vectores 5*: 23-34), isoenzymes (J Costa et al. 1997 *Mem Inst Oswaldo Cruz 92*: 459-464) and ecology (J Costa et al. 1998 *Mem Inst Oswaldo Cruz 93*: 7-13). Crossing experiments carried out among these four populations of *T. brasiliensis* demonstrated evidence of genetic incompatibility in F2 and F3 only when brasiliensis was crossed with melanica population. This may indicate that these two populations can be in the beginning of a process of reproductive isolation (J Costa et al. unpublished data).

Under the epidemiological point of view, it was observed that "brasiliensis" population is the most important, because of its widespread distribution (Maranhão, Piauí, Ceará, Rio Grande do Norte and Paraíba), highest natural infection level (15%) and ability to occupy a great variety of ecotopes (domiciliar and wild ones). The "macromelasoma and juazeiro" populations were reported only from Pernambuco and Bahia, respectively, occupying peridomiciliar and wild ecotopes. Nevertheless, no *T. cruzi* natural infection was found in specimens from these two populations. The "melanica" population, from the north of Minas Gerais, was only collected in natural ecotopes. It presented 6% of natural infection, and was considered as important in the maintenance of the wild cycle of *T. cruzi.* The strains of *T. cruzi* obtained from these *T. brasiliensis* populations were characterized phenotipically and genotipically (J Costa et al. 1996 *Rev Bras Med Trop 29*: 128-129) and their clustering in its respective zymodemes are in progress.

Since the description of Chagas disease, many changes in its epidemiology have been observed. Actually, drastic and deep environmental changes allow artificial ecotopes to be occupied by triatomines. The domiciliation of wild vectors of Chagas disease, human habits and migration are among the most important epidemiological features concerning the health authorities. The vector potentiality of species until now considered as secondary, or out of importance, to Chagas disease transmission, has to be evaluated. It is important to consider the fact that the process of domiciliation for a given species not only facilitates its survival but also its dispersion (OP Forattini 1980 *Rev Saúde Pública 14*: 265-299). Reports of wild species invading houses, make it difficult, in certain cases, to distinguish if this fact represents a simple invasion event or the beginning of a domiciliation process.

Besides the environmental changes, it is also known that modifications of bioclimatic factors may directly affect triatomines biology and distribution: higher temperatures may affect the geographical expansion in latitude and altitude of triatomine species. Domiciliated species are expected to exhibit shorter life cycle and higher population growth (SI Curto de Casas et al. 1994 *Entomologia & Vectores 1*: 51-64).

Epidemiological vigilance and new tools for genetic structure analysis of triatomines populations are necessary. Specific markers which permit to differentiate residual from invasive populations seems to be efficient to promote and to evaluate the control actions against Chagas disease vectors (JP Dujardin et al. 1997 *Acta Tropica 66:* 145-153, 1997 *J Med Entomol 34*: 544-551, 1998 *Ann Trop Med Parasitol 92*: 219-228).

The Amazon region, which corresponds to more than 40% of the Brazilian territory, presents one of the highest biodiversity in the planet. More than 500,000 km^2 of Amazon forest was devas-

tated in the last ten years (4.15% of the total area. http://www.ibge.gov.br). In this region, Chagas disease was always considered as a wild enzooty, and until now, at least 18 triatomine species have already been reported in this region, nine of them infected by *T. cruzi* or *T. cruzi* "like" (Coura et al. *loc. cit.*). The lack of data on probable new habitats for triatomines, the possible existence of new species and even the lack of detailed studies for the already recorded species, impair the estimation for Chagas disease spreading on Amazon region. Moreover, human migration from northeastern endemic areas of Brazil increases the risk of future endemies. The continuing vigilance, effective research and health education of the inhabitants focused to the importance to notifying the presence of triatomines inside the houses as performed in other endemic regions, are fundamental actions to understand, monitor and control Chagas disease transmission in these new environments.

Acknowledgement: to Dra Maria Goreti Rosa Freitas for critical reading of the manuscript.