

Short Communication

Biological characteristics of *Meccus phyllosomus pallidipennis* (Hemiptera: Reduviidae: Triatominae) fed on two different hosts

Ricardo Valenzuela-Campos^{[1]*}, Neretva Sinaí González-Rangel^{[1]*},
Benjamín Noguera-Torres^[2], Gumercindo Goicochea-Del Rosal^[3]
and José Alejandro Martínez-Ibarra^[1]

[1]. Universidad de Guadalajara, Centro Universitario del Sur, Laboratorio de Entomología Médica, Ciudad Guzman, Jalisco, México.

[2]. Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Becario de COFAA, Departamento de Parasitología, Ciudad de México, México.

[3]. Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales, Laboratorio de Ecología de Vectores, Buenos Aires, Argentina.

Abstract

Introduction: Different blood meal sources can affect biology of triatomines. **Methods:** We studied the influence of two different blood meal sources (rabbits and hens) on five biological parameters in *Meccus phyllosomus pallidipennis* and collected biological parameters. **Results:** The cohort fed on rabbits had a shorter median life-cycle and lower mortality rate than that fed on hens. Both cohorts required a similar number of blood meals to reach adulthood. Median longevity and number of blood meals for adults were similar between both cohorts. **Conclusions:** The studied parameters reflect the high grade of adaptation of *M. p. pallidipennis* feeding on different hosts.

Keywords: Biology. *Meccus phyllosomus pallidipennis*. Chagas disease. Mexico.

Chagas disease is a zoonosis transmitted in natural foci with defined environmental characteristics. It is estimated that between six and seven million people are infected by *Trypanosoma cruzi* around the world, with more than 5,700,000 infected people living in American countries and almost 900,000 infected in Mexico¹. Food resource use by triatomines has a direct effect on the developmental time of nymphs and adult reproduction, which are important regulating factors of population density². Published studies have demonstrated the influence of different blood meal sources on various biological parameters of different species of triatomines. The animals serving as blood meal sources in most of these comparative studies have been pigeons, mice, hens, and rabbits²⁻⁴. In most cases, the triatomines that feed on mammals have more

outstanding biological parameters than those that feed on birds²⁻⁴. Similarly, the influence of different blood meal sources on some feeding and defecation behaviors have been studied in *Meccus phyllosomus pallidipennis*, considered as one of the most important vectors of *T. cruzi* in Mexico⁴. Interestingly, based on their study of some biological parameters of *M. p. pallidipennis* in Brazil, some authors find it reasonable to assume the potential role of this species as a vector in environments other than those naturally found in Mexico. This implies that Brazilian environmental conditions would be favorable for survival of *M. p. pallidipennis*⁵. Study of longevity in triatomines contributes to estimating the importance of this species as a vector of *T. cruzi*, since this parameter affects its capacity to infest human dwellings⁶. Similarly, the number of blood meals required for triatomines to survive until the adult stage has not been studied, even though this information could contribute to estimating the importance of a specific triatomine species as a vector. This current study aimed to contribute to understanding the influence of feeding of different blood meal sources on the *M. p. pallidipennis* life-cycle, nymphal mortality, number of blood meals to reach adulthood, as well as on longevity and number of blood meals of adults.

*These two authors contributed equally to this study.

Corresponding autor: Dr. José Alejandro Martínez-Ibarra.

e-mail: aibarra@cusur.udg.mx

Orcid: 0000-0002-6600-654X

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The insects used in this study were selected from the third generation of a colony previously established from at least 30 individuals initially collected in Chilpancingo de los Bravos, Guerrero, Mexico (17°33'N, 99°30'W) in 2015. The initially collected specimens were identified according to the most commonly used taxonomic key by Lent and Wygodzinsky⁷, taking into account the revalidation of *Meccus*⁸. That colony, as well as the two studied cohorts of *M. p. pallidipennis*, were maintained under laboratory conditions similar to those in a past study on the biology of this species⁴, at 27 ± 1 °C and $75 \pm 5\%$ relative humidity (RH) and a photoperiod of LD 12:12. One of the studied cohorts was fed on immobilized and anesthetized Silver Marten rabbits (*Oryctolagus cuniculus*) and the other on Turken hens (*Gallus gallus domesticus*), on a fortnightly basis. Animals used as blood meal sources were anesthetized according to the Norma Oficial Mexicana regulations using 0.25 ml/kg of ketamine, which was applied intramuscularly according to established guidelines⁹. Eggs from a minimum of ten females of the colony were grouped by date of oviposition to initiate two cohorts of 100 eggs each. In order to estimate longevity data for each cohort, exact dates were recorded for when every nymph reached adult stage and when each individual died as an adult. Adults were also fed according to the blood meal source (hen or rabbit) selected for each cohort until death and every blood meal was recorded. A nonparametric *Mann-Whitney U-test* was used to compare the developmental cycle periods and number of blood meals needed to molt. The Chi-square test of homogeneity was used to compare percentages of both cohorts.

When the total egg-to-adult development times between the two cohorts were compared, a significantly less time ($U = 1041$, $p = 0.03$) was recorded for the cohort fed on rabbits (**Table 1**). No significant differences ($U = 1407$, $p = 0.54$) were recorded when comparing the total number of blood meals for molting through each nymphal instar of each cohort (**Table 1**). The total percentage of accumulative mortality was significantly lower ($\chi^2 = 2.9$, $p = 0.04$) in the cohort fed on rabbits (**Table 1**). The average length of adult survival was similar regardless of sex and cohort (**Table 2**), with no significant differences ($U = 1497$, $p = 0.12$) in females (or males) fed on hens compared to those fed on rabbits. Even though the number of blood meals among females fed on hens was lower than that of the cohort fed on rabbits, no significant differences were recorded ($U =$ from 1243, $p > 0.05$). Similarly, males fed on rabbits and those fed on hens had a different median number of blood meals in adulthood; however, these differences were not significant (**Table 2**).

Egg-to-adult development time of the two studied cohorts can be considered to be medium (around 7 months). This is equivalent to up to two generations obtained per year, which could lead to increased risk of vectorial transmission of *T. cruzi* to human and animal reservoirs, due to the high abundance of *M. p. pallidipennis*, a triatomine species with outstanding vectorial characteristics^{4,5}. Short development times could indicate how successful a triatomine population can be, since it represents the ability of a species to repopulate and re-establish after a disturbance, such as those caused by insecticides⁵. Development times of both cohorts were similar to those in a recent study of a

TABLE 1: Median time of development from egg to adult (in days), percentage of cumulative mortality and median number of blood meals to molt in nymphs of two *Meccus phyllosomus pallidipennis* cohorts.

Instar	Hen			Rabbit			
	n	Life cycle (interquartile range)	Mortality (%)	n	Life cycle (interquartile range)	Mortality (%)	Blood meals (interquartile range)
Egg-N1	93	19a (17-21)	-	78	19a (17-21)	-	--
N1-N2	87	19a (15-24)	6.45	73	17a (17-18)	6.41	1a (1-1)
N2-N3	79	22a (18-27)	8.60	68	25b (23-27)	6.41	1a (1-2)
N3-N4	77	40a (3.5-42)	2.15	65	26b (24-30)	3.85	2a (1-2)
N4-N5	73	52a (34-60)	4.30	60	42b (39-45)	6.41	2a (2-3)
N5-AD	64	60a (54-73)	9.68a	58	58b (54-63)	2.56b	2a (2-3)
Total	64	202a (178-225)	31.18a	58	191b (170-204)	25.64b	9a (8-10)

Medians in columns followed by different letters are significantly different ($p < 0.05$).

TABLE 2: Median number of blood meals to survive in adults and adult longevity (in days) of two *Meccus phyllosomus pallidipennis* cohorts.

Adults	Hen			Rabbit		
	n	Blood meals (interquartile range)	Longevity (interquartile range)	n	Blood meals (interquartile range)	Longevity (interquartile range)
Females	39	11a (7-20)	307.5a (130-467)	27	15b (9-18)	290a (123-338)
Males	25	10a (5-14)	356a (235-470)	31	6b (5-10)	369.5a (227.5-501)

Medians in columns followed by different letters are significantly different ($p < 0.05$).

M. p. pallidipennis population from southern Mexico, whereby two cohorts, one fed on hens (Red Star race), and one on rabbits (Chinchilla race), were studied. Similar to a previous study⁴ comparing *M. p. pallidipennis* development times between blood meal sources from two rabbit breeds (New Zealand vs. Chinchilla), when we combine with our current study, we also recorded an apparent lack of influence of rabbit breed (Silver Marten vs. Chinchilla vs New Zealand) on development times.

Unexpectedly, an apparent lack of influence of hen breed (Red Star vs. Turken) was noted in our study. This contrasts with a previous study⁴ that reported apparent influence of hen breed (Leghorn vs. Red Star) on development times. Similarly, no influence of the origins of both *M. p. pallidipennis* populations (southern for current and western Mexico for the previous one) was noted⁴. Development time results for both cohorts were shorter than those for *Triatoma sherlocki* (621 days) and for *Panstrongylus chinai* (371 days)^{10,11}. In contrast, both cohorts showed slightly longer development times than those for a western Mexican population of *T. lecticularia* (168 days)¹². *T. lecticularia* is an important vector of *T. cruzi* in some areas of northeastern and northwestern Mexico and in the United States¹². Similar to a previous study where two cohorts (fed on Red Star hens or Chinchilla rabbits) of a *M. p. pallidipennis* population from western Mexico were compared, egg-to-adult development time for the cohort fed on rabbits (a mammalian) in our study were shorter than that those fed on hens (avian)⁴. These findings are consistent with different epidemiologically important South American species such as *T. infestans*, *T. sordida*, *T. pseudomaculata* and *T. brasiliensis*, in which cohorts fed on mice had shorter egg-to-adult development times than those fed on pigeons³.

All specimens from the two cohorts required a medium total number (9) of blood meals to molt, independent of blood meal source. This finding represents two advantages. First, a medium number of required blood meals indicates that these triatomines have a lower risk of being killed by adverse environmental conditions (e.g., rain) when they leave their shelter or being eaten by a predator, since triatomines are at risk each time they leave their shelter to find a host¹³. Second, acquiring a similar number of blood meals indistinctively from mammalian or avian source represents an advantage for *M. p. pallidipennis*, because that behavior means having access to a broader range

of available hosts, and, as a consequence, such behavior may increase their chances of survival.

Mortality rates of both studied cohorts were more than 25%, but the rate for those fed on hens was slightly higher (31%). These similar rates of around 30% support that *M. p. pallidipennis* is well adapted to commonly feed on both mammals and birds under field conditions, as has been suggested by previous data of blood meals of collected triatomines under field conditions¹⁴. Similar results have also been recorded for three species fed on mammals and birds, including *T. pseudomaculata* and *T. sordida*, which are two important vectors for *T. cruzi* transmission in South America³.

In both cohorts, *M. p. pallidipennis* males in the current study lived for a median duration of over 1 year, whereas females lived for a median duration of around 10 months, independent of the blood meal source. Adaptability of males and females to both blood meal sources suggests an advantage for survival of *M. p. pallidipennis*. Both sexes of *M. p. pallidipennis* lived for long durations as adults (around 11 - 11.5 months), similar to those of *T. melanica* and *T. brasiliensis*, which are two important vectors of *T. cruzi* in Brazil, as well as males of *M. p. pallidipennis* (= *T. pallidipennis*) (around 1 year old) fed on Leghorn hens in previous studies^{4,6}. Both sexes of *M. p. pallidipennis* lived for longer durations as adults than *T. carvalhoi* (males = 180 days, females = 160 days), an important vector of *T. cruzi* in Brazil¹⁵. Females of both cohorts lived around 70 days (median) less than males of both cohorts, with similar median times between both cohorts. These differences could be attributed to reproduction costs, as has been reported in previous studies of *M. p. pallidipennis* and *T. melanica*^{4,6}. To our knowledge, this is the first study to investigate the number of blood meals required for survival among adults of a triatomine species. For *M. p. pallidipennis*, this number was similar for females and males of both cohorts, supporting that *M. p. pallidipennis* has a high capacity to adapt to different blood meal sources. Results from both cohorts showed that every *M. p. pallidipennis* individual fed on a host about 20 times during its complete life of around 500 days, from hatching to death. This supports that *M. p. pallidipennis* could survive at least a month of starvation, which allows this species to remain sheltered during adverse external environmental conditions (e.g., rain, cold), or survive even if a host is not available. These results also suggest that

every individual has many chances of transmitting *T. cruzi* to the hosts if infected, thus increasing its importance as a vector.

Most of the studied parameters, including those previously not studied (longevity and number of blood meals at adult stage), showed that *M. p. pallidipennis* is well adapted to feed on different hosts, which represents a higher risk of successful invasion among human dwellings, and, as a consequence, an increased risk of *T. cruzi* transmission to humans, as *M.p. pallidipennis* is considered an effective vector of this protozoa⁴.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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