

## Difference in Biological Characteristics between *Aedes togoi* Originated from Thailand and Japan

Akio MORI<sup>1)</sup>, Kazuo BUÉI<sup>2)</sup>, Prakong PHAN-URAI<sup>3)</sup> and Koichiro FUJITA<sup>1)</sup>

1) Department of Medical Zoology, Nagasaki University School of Medicine

2) Department of Medical Zoology, Osaka City University Medical School

3) Division of Medical Entomology, Department of Medical Sciences, Thailand

**Abstract:** Some biological characteristics between strains of *Aedes togoi* from Chantaburi, Thailand, and Nagasaki, Japan, were compared. The larval plus pupal period of Chantaburi strain was longer than that of Nagasaki strain. At low temperature and short photoperiod, such as 21°C, 10 hr daylength or 15°C, 10 hr daylength, the fourth instar larvae of Nagasaki strain entered into larval diapause, while Chantaburi strain did not enter into diapause. The adult body size of Chantaburi strain was smaller than that of Nagasaki strain. The autogenous reproduction of Chantaburi strain was high even at any temperature. From these results, *Ae. togoi* seems to be an indigenous mosquito in Thailand, but not to be a stowaway in recent years from the temperate zone.

**Key words:** *Aedes togoi*, Geographical variation, Thailand, Japan.

### INTRODUCTION

Recently, *Aedes togoi* has been collected from several places in Southeast Asia (Ramalingam, 1969) and North America (Sollers-Riedel, 1971). Ramalingam supposed that *Ae. togoi* in West Malaysia might have been introduced from Japan by Japanese ships in recent years, because this species is primarily a mosquito of the temperate zone. However, he recognized slight morphological differences between *Ae. togoi* collected from West Malaysia and the laboratory colony originated from Taiwan. As the authors could collect *Ae. togoi* from rock pools at a small island in Thailand, the biological characteristics of this strain was compared with those of Japanese strain.

### MATERIALS AND METHODS

Detailed histories of Thai (Chantaburi strain) and Japanese (Nagasaki strain) *Ae.*

---

Received for Publication, July 12, 1985

Contribution No. 292 from the Department of Medical Zoology, Nagasaki University School of Medicine.

*togoi* used in the present experiment were described in the previous paper (Mori *et al.*, 1985).

To compare biological characteristics of *Ae. togoi* between both strains, mosquitoes were reared in the insectaria with controlled environment of 15°C and 98% RH under 10 hr daylength, 21°C and 70% RH under 10 hr daylength, 25°C and 80% RH under 16 hr daylength, and 30°C and 90% RH under 16 hr daylength. One hundred first instar larvae of each strain, within 10 hr after hatch, were put in enamel pans (22×28×4 cm), which contained about 1,500 ml of water, at each condition. Equally mixed powder of Brewer's yeast and mouse pellets was served as the larval food. A suspension of 0.2g of this powder in water was added to each pan every day. Pupae were picked up and placed in cups with water for emergence. The resulting adults were provided with maintenance diet of 2% sugar solution. Females in 15°C and 21°C were killed 7 days after emergence, and wing length was measured and the number of ovarioles and mature eggs in one of two ovaries were counted. In this paper, producing mature eggs in the ovaries without blood meal is referred to as autogeny. Females in 25°C and 30°C were killed 3 days after emergence and treated as stated above.

## RESULTS

Median period from egg hatch to adult emergence of both strains at various temperatures are given in Table 1. In Nagasaki strain, a few out of the larvae reared at 21°C under 10 hr daylength and most at 15°C under 10 hr daylength stopped their development at the fourth instar larvae. They were considered to have entered into diapause at low temperature and short photoperiod, because they never molted until environmental conditions were changed to high temperature and long photoperiod. These diapausing larvae were not included in the calculations in Table 1. The larval plus pupal period of both females and males of Chantaburi strain had a tendency to be longer than that of Nagasaki strain, especially in lower temperatures.

Table 1. Median intervals in days from egg hatch to adult emergence of *Aedes togoi* originated from Chantaburi, Thailand, and from Nagasaki, Japan, at various temperatures

Temp.	Strain		Nagasaki	
	Chantaburi			
	Male	Female	Male	Female
30°C	9.60	10.14	8.48	9.04
25°C	13.67	14.91	13.51	14.43
21°C	20.83	23.15	20.38	21.24
15°C	35.10	39.12	29.97	31.19

Table 2 shows the rate of autogenous females, which produced mature eggs without blood meals. The rate became higher with decreasing temperature in both strains. The rate of autogenous females was very variable in Nagasaki strain ranging from 86.7% at 15°C to 0% at 30°C, while in Chantaburi strain the rate was 100% at 21°C and lower temperatures, and dropped to 80% at 30°C. The influence of temperature seems to be more significant in Nagasaki strain.

Table 2. Rate of autogenous females of *Aedes togoi* originated from Chantaburi, Thailand, and from Nagasaki, Japan, at various temperatures

Temp. \ Strain	Chantaburi	Nagasaki
30°C	80.0%	0.0%
25°C	96.7%	33.3%
21°C	100.0%	80.0%
15°C	100.0%	86.7%

The number of ovarioles in one of the two ovaries was shown in Table 3, and the number of mature eggs in the autogenous females in Table 4. In Chantaburi strain, the number of both ovarioles and mature eggs had a tendency to decrease with increasing temperature. At 25°C and lower temperatures, more than 70% follicles grew up to mature

Table 3. Number of ovarioles (mean±S. D.) in an ovary of *Aedes togoi* originated from Chantaburi, Thailand, and from Nagasaki, Japan, at various temperatures

Temp. \ Strain	Chantaburi	Nagasaki
30°C	73.9± 9.5	108.9±14.9
25°C	83.7±11.5	147.3±19.2
21°C	88.6±11.9	110.6±18.3
15°C	94.8±14.9	90.5±14.1

Table 4. Number of mature eggs (mean±S.D.) in autogenous females of *Aedes togoi* originated from Chantaburi, Thailand, and from Nagasaki, Japan, at various temperatures

Temp. \ Strain	Chantaburi	Nagasaki
30°C	19.5± 7.9	—
25°C	59.4± 9.7	35.9±18.0
21°C	77.4±12.8	33.4±13.7
15°C	71.7±11.3	26.0± 8.0

stage, and even at 30°C 26.4% of ovarioles included mature eggs. On the other hand, in Nagasaki strain, a clear Cline with temperature was not recognized in the number of ovarioles or mature eggs. The number eggs in Nagasaki strain was smaller than in Chantaburi strain at the same temperature, though the former had larger of ovarioles.

The wing length in both strains was given separately for autogenous and anautogenous females in Table 5. The wing length of females shortened with increasing temperature in both strain whether autogenous or not, but in Chantaburi strain it was considerably shorter than in Nagasaki strain in any conditions. The differences in wing length between autogenous and anautogenous females in each condition were not statistically significant.

Table 5. Wing length (mean [mm]±S. D.) of *Aedes togoi* females originated from Chantaburi, Thailand, and from Nagasaki, Japan, at various temperatures

Temp.	Chantaburi		Nagasaki	
	Autogenous	Anautogenous	Autogenous	Anautogenous
30°C	2.85±0.10 <sup>a</sup>	2.82±0.17 <sup>a</sup>	—	3.56±0.17
25°C	3.35±0.12	3.10*	4.11±0.09 <sup>b</sup>	4.06±0.12 <sup>b</sup>
21°C	3.98±0.09	—	4.42±0.11 <sup>c</sup>	4.39±0.08 <sup>c</sup>
15°C	4.00±0.13	—	4.32±0.17 <sup>d</sup>	4.26±0.05 <sup>d</sup>

\* Only one female emerged.

a, b, c, d: Values followed by the same letter are not significantly different at the 5% level (t-test).

## DISCUSSION

O'Meara and Craing (1969) stated that the autogeny in *Ae. atropalpus* is controlled by a single dominant, autosomal gene. Both quantity and quality of larval food also influence the expression of autogeny in some mosquito species (Kardos, 1959; Lea; 1964; O'Meara and Krasnick, 1970; Tate and Vincent, 1963). Thomas and Leng (1972) showed the high rate of autogeny in *Ae. togoi* originated from West Malaysia. They indicated that polygenes influenced the autogeny in this species from the crossing experiment with an anautogenous strain from Taiwan. In the present experiment with *Ae. togoi* originated from Thailand and Japan, it became clear that the temperature in larval and pupal stages had remarkably influence on the expression of autogeny.

Laurence (1964) and Wada and Shirasaka (1972) said that the autogeny in *Ae. togoi* was found in the females with long wing. In the present experiment there was a tendency that the wing of autogenous females was longer than that of anautogenous females, though the statistical difference was not recognized between them. However, Thomas and Leng (1972) did not recognized the difference in wing length between autogenous and anautogenous females.

Under the same rearing condition, the interval between egg hatching to adult emergence of Chantaburi strain is longer than that of Nagasaki strain in any conditions. This is contrary to the results obtained in the experiments to compare Thai and Japanese strain of *Culex tritaeniorhynchus* (Mori *et al.*, 1984) and *Ae. albopictus* (Mori and Phanthumachinda, 1982). It seems that *Ae. togoi* of Chantaburi strain requires longer larval period to take more nutrition for developing eggs autogenously.

Most remarkable difference between these two strains of *Ae. togoi* is that the fourth instar larvae of Nagasaki strain enter into diapause at the condition of low temperature and short photoperiod, while the larvae of Chantaburi strain do not enter into diapause at the same condition.

From these results, it becomes clear that some biological characteristics are different between Thai and Japanese *Ae. togoi*, and this species seems to be a indigenous mosquito in Thailand but not to be a stowaway in recent years from the temperate zone as Japan. However, *Ae. togoi* both in Thailand and Japan has the susceptibility to *B. malayi* (Mori *et al.*, 1985).

#### ACKNOWLEDGEMENTS

The authors express their sincere thanks to Dr. Yoshito Wada, National Institute of Health, Tokyo, for his critical reading of this manuscript.

#### REFERENCES

- 1) Kardos, E. H. (1959): The effects of larval nutritional level on development of autogeny in colony *Culex tarsalis* Coq. Proc. Calif. Mosq. Contr. Assoc., 27, 71-72.
- 2) Laurence, B. R. (1964): Autogeny in *Aedes (Finlaya) togoi* Theobald (Diptera: Culicidae). J. Ins. Physiol., 10, 319-331.
- 3) Lea, A. O. (1964): Studies on the dietary and endocrine regulation of autogenous reproduction in *Aedes taeniorhynchus* (Wied.). J. Med. Ent., 1, 40-44.
- 4) Mori, A. & Phanthumachinda, B. (1982): Studies on the biological characteristics of *Aedes albopictus* originated from Thailand. Jap. J Sanit. Zool., 33, 271. (in Japanese)
- 5) Mori, A., Buéi, K., Phan-Urai, P., Phonchevin, T., Inthraudom, P., Phanthumachinda, B. & Hasegawa, M. (1984): Difference in characteristics of *Culex tritaeniorhynchus* originated from Thailand and Japan. Trop. Med., 26, 75-86.
- 6) Mori, A., Fujita, K., Buéi, K. & Phan-Urai, P. (1985): Comparison of susceptibility to *Brgia malayi* between strain of *Aedes togoi* originated from Thailand and Japan. Trop. Med., 27, 277-281.
- 7) O'Meara, G. F. & Craig, G. B., Jr. (1963): Monofactorial mode of inheritance of autogeny in *Aedes atropalpus*. Mosquito News, 29, 14-22.
- 8) O'Meara, G. F. & Krasnick, G. J. (1970): Dietary and genetic control of the expression of autogenous reproduction in *Aedes atropalpus* (Coq.) (Diptera: Culicidae). J. Med. Ent., 7, 328-

334.

- 9) Ramalingam, S. (1969): New record of *Aedes (Finlaya) togoi* (Theobald) in West Malaysia.. Med. J. Malaya, 23, 288-292.
- 10) Sollers-Riedel, H. (1971): 1970 world studies on mosquitoes and diseases carried by them. Proc. 58th Ann. Meet. N. J. Mosq. Exterm. Assoc. Suppl. 52p.
- 11) Tate, P. & Vincent, M. (1936): The biology of autogenous and anautogenous races of *Culex pipiens* (Diptera: Culicidae). Parasitology, 28, 155-145.
- 12) Thomas, V. & Leng, Y. P. (1972): The inheritance of autogeny in *Aedes (Finlaya) togoi* (Theobald) from Malaysia and same aspects of its biology. Southeast Asian J. Trop. Med. Pub. Hlth., 3, 163-174.
- 13) Wada, Y. & Shirasaka, A. (1972): [Studies on autogeny in *Aedes togoi*.] Jap. J. Sanit. Zool., 22, 234. (in Japanese)

タイ国と日本のトウゴウヤブカの形質の違いについて

森 章夫<sup>1</sup>, 武衛和雄<sup>2</sup>, Prakong PHAN-URAI<sup>3</sup>, 藤田紘一郎<sup>1</sup> (1長崎大学医学部医動物学教室  
<sup>2</sup>大阪市立大学医学部医動物学教室, <sup>3</sup>タイ国医科学局衛生昆虫部)

近年、トウゴウヤブカが東南アジアで採集されるようになったが、これは日本から運ばれたものではないかとの説もあるので、この点を明らかにするためタイ国チャンタブリと長崎で得られたトウゴウヤブカを同一条件で飼育し、両者の形態および生理、生態の比較を行った。どの温度条件でも長崎系の方が幼虫・蛹期間は短い、羽化成虫は大きく、卵巣小管数も多かった。しかし、無吸血状態では成熟卵の形成雌率はチャンタブリ系の方が高いうえ、1雌あたりの成熟卵数も多かった。また長崎系では無吸血での成熟卵形成におよぼす飼育温度の影響がチャンタブリ系のものよりも大きかった。低温短日で飼育した場合に長崎系は4令幼虫で休眠に入るのに対し、チャンタブリ系では休眠せずに羽化している。このようにチャンタブリ系の形質は長崎系のものとはかなり異なっているので、トウゴウヤブカは以前からタイ国に分布していると考えられる。

熱帯医学 第27巻 第4号, 283-288頁, 1985年12月