

Temperature effect on the siphonal index of larvae in the urban mosquito, *Culex pipiens f. molestus* Forskål (Diptera: Culicidae)

Влияние температуры на сифональный индекс личинок городского комара *Culex pipiens f. molestus* Forskål (Diptera: Culicidae)

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KEY WORDS: *Culex pipiens f. molestus*, siphonal index, variation, temperature.

КЛЮЧЕВЫЕ СЛОВА: *Culex pipiens f. molestus*, сифональный индекс, изменчивость, температура.

ABSTRACT. It was experimentally shown that the mean siphonal index in the urban mosquito, *Culex pipiens f. molestus*, is modified by temperature during larval development. It comprises 4.20 and 4.07 at 13 and 25°C, respectively.

РЕЗЮМЕ. Экспериментально показано, что сифональный индекс личинок городского комара *Culex pipiens f. molestus* модифицируется температурой развития личинок, составляя 4,2 и 4,07 при 13 и 25°C, соответственно.

Introduction

The siphon of the larvae of culicids carries out the important physiological function as a respiratory organ. Its various morphological structures (tufts, setae, combs, scales, etc.) are used as diagnostic characters for differentiation of genera and species of mosquitoes [Gutsevich et al., 1970]. The siphonal index of the larvae (the ratio of the length of the siphon to its width at the base) is an important character, which is used for identification of the members of the mosquito complex *Culex pipiens* [Brogdon, 1984; Ishii, 1991; Kruppa, 1988; Vinogradova, 1966, 1997, 2000]. The northern house mosquito is one of two main members of this complex. These mosquitoes are known as bloodsuckers actively attacking humans, primarily in urban environments, and as vectors of various agents that infect man and/or animals (Western equine, St Louis and Japan encephalites; West Nile and Rift Valley fever viruses and Ockelbo disease) [Vinogradova, 2000; Petersen et al., 2002; Gratz, 2004]. *Culex pipiens* Linnaeus, 1758 is presented by two forms or ecotypes, *C. pipiens s. str.* and the form *molestus* Forskål, 1775. Many authors considered the latter form as a distinct species [e.g., Harbach et al., 1984]. Both forms are similar morphologically but not biologically. The form *molestus* is characterized by autogeny (the production of viable eggs without blood meal), stenoga-

my (the ability to mate readily in a small cage) and the absence of diapause, whereas the form *pipiens* is anautogenous, eurygamous and has diapause. In *C. pipiens* the mean siphonal index (MSI) is strongly correlated with ecology (under- or overground water body types) and adult physiology (autogeny). In spite of high geographical and individual variation, which makes the identification of individual larvae difficult, MSI can be used with certainty for discrimination between populations of the two forms. In the form *molestus* it equals 4.4 or less, in *C. pipiens s. str.*, 4.8 or more [Vinogradova et al., 1996]. It is known that temperature experienced during larval development can slightly affect the siphonal index in the laboratory strains of the *molestus* form [Urbanelli et al., 1981; Vinogradova, 2000].

The present paper deals with the temperature effect on the siphonal index of larvae of the urban mosquito, *Culex pipiens f. molestus*.

Material and methods

The urban mosquito, *C. pipiens f. molestus* from Krasnodar, was cultivated during 5 years under constant laboratory conditions (25°C, 12 hours of light per day). The method of mosquito rearing was described earlier [Vinogradova, 1966]. This strain was reared continuously without blood feeding (i.e., from autogenous egg batches). The larvae of the 1st instar emerged during 10–20 hours from 15–20 egg batches were divided into two groups: one group was bred at 25°C (12 hours of light per day), and another one was kept at 13°C (in the dark). Each experiment included four replicates which were originated from two different strain generations. The mature 4th instar larvae were fixed in 70% ethanol. The length and width of the larval siphon and the width of the head capsule were measured with a binocular MBS-1 at a magnification 32×. The statistical treatment of results was made using “Systat” software. ANOVA analysis and regression analysis were performed.

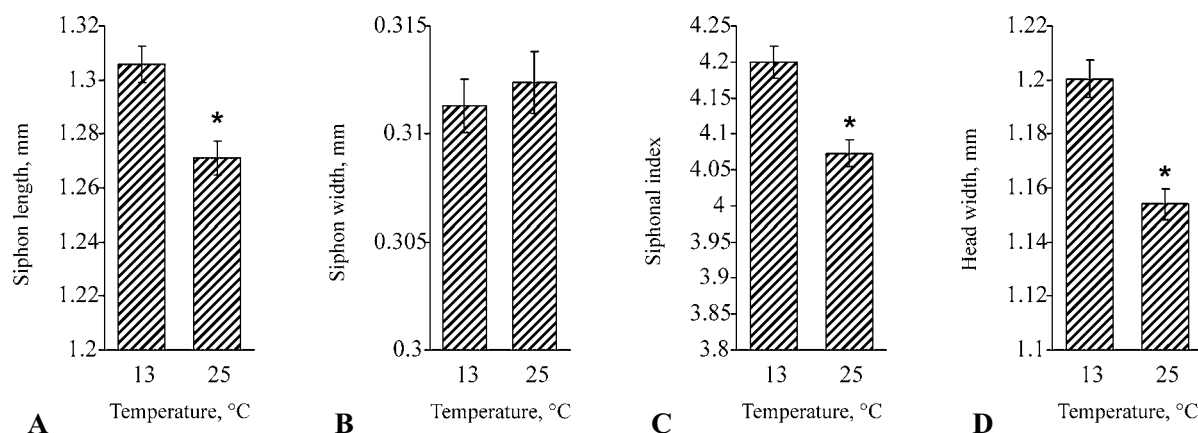


Fig. 1. Temperature effect on the some morphometric characters of larvae in the urban mosquito, *Culex pipiens f. molestus*: A — siphon length; B — siphon width; C — siphonal index; D — head width.

* The difference between the mean values at 13°C and 25°C is significant at $p = 0.001$.

Рис. 1. Влияние температуры на некоторые морфометрические показатели личинок городского комара, *Culex pipiens f. molestus*: А — длина сифона; В — ширина сифона; С — сифональный индекс; D — ширина головы.

* Различия средних значений при 13°C и 25°C статистически достоверны ($p = 0,001$).

Results and discussion

Results of the experimental study of the temperature effect on four size parameters of the larvae in the urban mosquito are presented in Table 1 and Figure 1 A–D. The mean length of siphon depended significantly (ANOVA, $p < 0.001$) on the temperature of larval development: it was 1.30 mm and 1.27 mm at 13°C and 25°C, respectively (Fig. 1 A). On the contrary, the width of siphon varied insignificantly (ANOVA, $p > 0.05$) (Fig. 1 B). The siphonal index and head width were significantly lower (ANOVA, $p < 0.001$) at the higher temperature (Fig. 1 C–D). The width of head capsule, which was used as a criterion of larval body

Table 1. Influence of temperature on some morphometric characteristics of the larvae in the urban mosquito, *Culex pipiens f. molestus*.

Таблица 1. Влияние температуры на некоторые морфометрические показатели личинок городского комара *Culex pipiens f. molestus*.

Characteristics	13°C	25°C
Mean siphon length, mm M ± SE (n)	1.30±0.073 (124)	1.27±0.006 (115)
Mean siphon width, mm M ± SE (n)	0.311±0.001 (124)	0.312±0.001 (115)
Mean siphonal index M ± SE (n)	4.2±0.022 (124)	4.07±0.019 (115)
Mean head width, mm M ± SE (n)	1.20±0.006 (74)	1.15±0.006 (70)

Abbreviations: M — mean; SE — standard (mean-square) error; total numbers of larvae (n) are in parentheses.

Сокращения: М — среднее; SE — среднеквадратичная ошибка; общее число личинок (n) указано в скобках.

size, was positively and significantly correlated with the length of the siphon ($r=0.71$, $p < 0.001$).

The observed effect of temperature on the siphonal length and the width of head capsule is consistent with our previous data on the same *Culex pipiens* form. Similar dependence on temperature was revealed in the expression of autogeny and autogenous fecundity as well as the wing length of females [Vinogradova & Karpova, 2006].

It is known that siphonal index is genetically determined. The results of crossing experiments between autogenous and anautogenous forms of *C. pipiens* demonstrated that the hybrids had the intermediate MSI values [Vinogradova, 1997]. Our results have shown that the mean siphonal index may be also greatly modified by temperature conditions during the larval development. Probably, a high level of individual variation in the siphonal index is typical for *C. pipiens* larvae [Vinogradova, 2000].

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