

Zoology

Investigation of DNA Synthesis Intensity among the Functionally Distinguished Flight Muscles in the Process of Locust Development

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ABSTRACT. DNA synthesis intensity (^3H -thymidine was used as a marker) among functionally different monofunctional (MOF) and bifunctional (BIF) flight muscles (dorsal longitudinal 112, tergosternal 113, tergocoxal 119,120) in the process of locust development (the 5th age larva, one-day and mature imago) was investigated. It was determined that the intensity of DNA synthesis in the locust functionally different MOF and BIF flight muscles of one-day imago is several times higher than that of the 5th age larva and mature imago. In MOF muscle 112 of one-day imago as well as in the case of mature locust the level of DNA synthesis was low. The difference among DNA synthesis in other muscles (113, 119,120), as well as in the case of MOF and BIF muscles of the 5th age larva was not observed. The sufficient difference among DNA synthesis in MOF and BIF muscles in the process of locust development was not observed. © 2014 Bull. Georg. Natl. Acad. Sci.

Key words: flight muscles, monofunctional muscle, bifunctional muscle, DNA synthesis, locust.

Recently, the functionally different flight muscles of insects are being intensively studied. Proceeding from their functions the flight muscles are divided into MOF and BIF muscles [1]. The functional difference of these muscles is that BIF muscles participate in the movement of wings and extremities while MOF muscles only in wings movement. At present the morphology [2-6], histochemistry [7-10], physiology [11], morphometry [12,13], the consistence of

myofibrillar proteins [14], cation consistence [15] of MOF and BIF flight muscles are investigated quite in detail.

The muscles are shown to differ in some parameters (ultrastructure, histochemistry, morphometry etc.).

In this paper we intended to study the dynamics of DNA synthesis intensity among MOF and BIF flight muscles in the process of locust development.

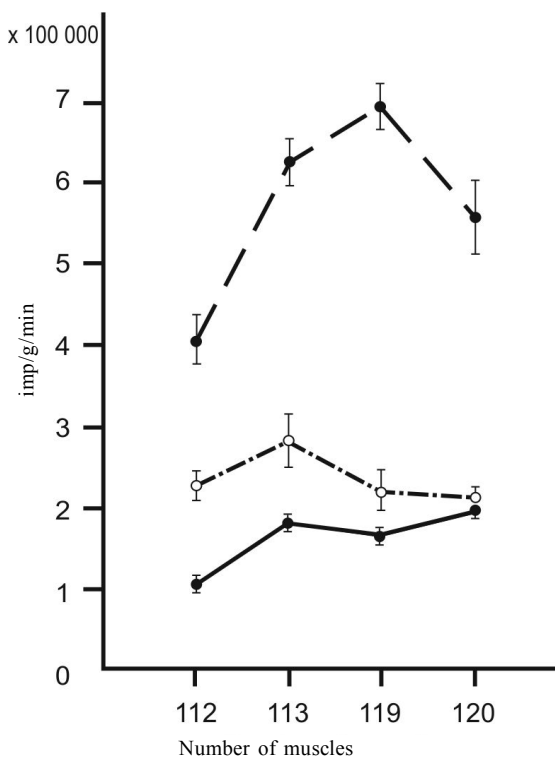


Fig. The intensity of DNA synthesis among functionally distinguished flight muscles in the process of locust development

- the 5th age larva
- one-day imago
- mature imago

Materials and Methods

The experiments were conducted using the laboratory culture of locust (*Locusta migratoria migratorioides* R.F.). The insects were kept in the hothouse for a year at 28-30 °C with eternal photoperiod (12 hours light and 12 hours darkness). In such conditions the culture develops well for the whole year.

For investigations we used dorsal longitudinal 112 and tergosternal 113 muscles out of MOF muscles and tergocoxal 119 and 120 muscles from BIF muscles. The figural marking of muscles is given according to anatomical nomenclature of Snodgrass [16].

The muscles for investigation were taken from the 5th age larva, one-day and mature imago. The intensity of DNA synthesis was studied by means of radiometric method using ³H-thymidine. Isotope was

brought in among the segments of bellies of insects (only one injection 5mCi per insect) and then they were returned to the hothouse. In 24 hours after the injection of marker the muscles were prepared, thoroughly washed and placed in scintillating solution. The amount of impulses was recorded on the autoanalyser of radioactivity “Бера-2” (Russia) during a minute and evaluated per one gr. of tissue. For accuracy of the results the muscles from right and left sides of thorax were taken separately and were compared with each other according to the number of impulses. This allowed to control the intensity of isotope inclusion more precisely. The obtained results were elaborated statistically (calculation of arithmetical mean and its standard mistake $X \pm S_x$).

Results and Discussion

Our investigation showed that intensity of DNA synthesis in MOF muscle 112 was lower than in the other MOF and BIF flight muscles of mature locust. The intensities of DNA synthesis in MOF muscle 113 and BIF muscles 119 and 120 do not differ (Fig. 1, Table 1). In the case of one-day imago the picture is the same: the intensity of DNA synthesis in MOF muscle 112 was lower than in the other flight muscles. Concerning the other MOF muscle 113, the intensity of DNA synthesis in it is higher. On that phase of development muscles 113, 119, 120 do not differ (Fig.). The difference among DNA synthesis in MOF and BIF muscles of the 5th age larva was not observed (Fig., Table 1). The level of DNA synthesis in functionally distinguished flight muscles of larva is a bit higher than that of MOF muscles (112, 113) of mature imago unlike the one-day imago.

The flight muscles on the investigated stages of locust development differ in the intensity of DNA synthesis. Particularly, DNA synthesis in MOF and BIF muscles of one-day imago is several times higher than in those of the 5th age larva and mature imago (Fig., Table 1). The obtained results are in good accordance with the data of investigations

Table 1. The intensity of DNA synthesis among the functionally distinguished flight muscles in the process of locust development (imp/g/min)

The investigated subjects	The stages of locust development		
	the 5 th age larva	one-day imago	mature imago
Dorsal longitudinal 112 (MOF)	227941.15 ± 34626.98 <i>n</i> = 13	404573.72 ± 38488.08 <i>n</i> = 11	104229.19 ± 11913.61 <i>n</i> = 21
Tergosternal 113 (MOF)	285684.27 ± 54575.46 <i>n</i> = 11	623570.42 ± 49596.34 <i>n</i> = 7	184201.9 ± 18058.42 <i>n</i> = 21
Tergocoxal 119 (BIF)	221972.0 ± 45021.55 <i>n</i> = 9	700681.9 ± 48140.70 <i>n</i> = 10	168124.8 ± 14054.14 <i>n</i> = 20
Tergocoxal 120 (BIF)	211509.8 ± 41540.8 <i>n</i> = 10	561442.5 ± 74569.93 <i>n</i> = 8	201909.2 ± 16356.36 <i>n</i> = 15

Note: *n* – means the number of investigated muscles

of functionally distinguished flight muscles [3,4,6,12,13]. It has been shown that during the process of locust imago development from the first up to 10 days muscle tissue grows intensively. The diameter of MOF and BIF muscle fibres grows almost twice - the diameter of muscle 113 grows from 16.0 up to 30.1 mm and the diameter of muscle 119 grows from 19.7 up to 35.2mm [3,5,12,13].

Hence, the slight difference of the intensity of DNA synthesis in functionally distinguished MOF

and BIF flight muscles at studied periods was shown only between MOF muscles (112) of one-day and mature imagoes. In other muscles (113, 119 and 120) the difference was not observed. The highest intensity of DNA synthesis was revealed in MOF and BIF flight muscles of one-day imago, and the lowest – in the case of mature imago.

So, in DNA synthesis of functionally distinguished flight muscles at studied periods of locust development sufficient difference was not observed.

ზოოლოგია

დნმ-ს სინთეზის ინტენსივობის შესწავლა ფუნქციურად განსხვავებულ საფრენ კუნთებს შორის კალიის განვითარების პროცესში

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შესწავლილია დნმ-ს (გამოყენებული იყო ^3H -თიმიდინი) სინთეზის ინტენსივობა ფუნქციურად განსხვავებულ მონოფუნქციურ (მოფ) და ბიფუნქციურ (ბიფ) საფრენ კუნთებში (დორსალური სიგრიძე 112, ტერგოსტერნული 113, ტერგოკოკსური 119, 120) კალიის განვითარების პროცესში (მე-5 ასაკის ლარვა, ერთდღიანი და სქესმწიფე იმაგო). კალიის ერთდღიანი იმაგოს მოფ და ბიფ კუნთებში დნმ-ს სინთეზის ინტენსივობა მაღალია, მე-5 ასაკის ლარვასა და სქესმწიფე იმაგოს კუნთებთან შედარებით, მოფ კუნთ 112-ში. ერთდღიან და სქესმწიფე კალიის შემთხვევაში გამოვლინდა დნმ-ს სინთეზის დაბალი დონე. მე-5 ასაკის ლარვის მოფ და ბიფ კუნთებს შორის განსხვავება არ აღინიშნება. ამრიგად, კალიის განვითარების პროცესში მოფ და ბიფ საფრენ კუნთებს შორის დნმ-ს სინთეზის ინტენსივობაში მნიშვნელოვანი განსხვავება არ გამოვლინდა.

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Received January, 2014