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Effect of Scorpion [*Heterometrus fulvipes*] Venom on Succinate dehydrogenase Rhythmicity in the Mouse, *Mus booduga*

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Envenomation inhibited the activity levels of SDH in the tissues of *Mus booduga*. Control animals exhibited dielrhythmicity in SDH activity while envenomated animals showed fluctuations in the phase ($\Delta\phi$), amplitude (A), acrophase (ϕ) and the maximal and minimal activity hours (X_{max} and X_{min}).

Key Words: Envenomation, Amplitude, Acrophase, Rhythmicity

Introduction

Scorpion venom produced alterations in the oxidative enzymes in the tissues of cockroach (Babu et al. 1971, Rajarami Reddy et al. 1980), lizard (Govardhana Reddy 1980), mouse (Maniraj Bhaskar 1980) and guinea pig (Vijayakumari et al. 1982). The present study was aimed at studying the effect of envenomation on the rhythmic pattern of succinate dehydrogenase (SDH) the citric acid cycle enzyme, in the tissues of *Mus booduga*.

Material and Methods

Venom was collected from adult healthy scorpions (*Heterometrus fulvipes*) following the method of Babu et al. (1971). It was diluted with physiological saline (0.9% NaCl) before using for experimentation.

Laboratory-acclimatized male mice weighing 10 ± 2 were selected for experimentation, since reproductive cycles in females were known to affect the rhythmicity (Lipton & Sutherland 1970). 50% lethal dose (LD 50/2 days) was determined by the method of Carpenter (1975). Sublethal dose of venom (9.4 μg i.e. 1/3 of LD_{50}) was administered to the mice. Since venom fractions are mostly proteins (Zlotkin et al. 1972), the amount of venom injected is expressed as protein content in μg. Envenomated animals were designated as experimental animals and saline-injected animals 'as controls'.

To study the circadian rhythmicity of SDH, six timings were selected arbitrarily from 24 hr solar day, viz., 08, 12, 16 (light hour half cycle), 20,00,04 (dark hour-half cycle).

The tissues selected for the study were the envenomated leg muscle (EM), contralateral leg muscle (CM), brain, and liver. The studies were made two days after envenomation, so that the animals were relieved of the envenomation shock (Maniraj Bhaskar 1980).

SDH activity was assayed by the method of Nachlas et al. (1960) and the protein content by the method of Lowry et al. (1951). Statistical treatment of the data was done by linear regression analysis as per Bliss (1970).

Results and Discussions

Scorpion venom inhibited SDH activity significantly and the per cent inhibition was in the order of EM>CM>liver> brain (table 1 and figure 1). The mean enzyme levels (MELs) in both normal and experimental animals were high during light hour half cycle than the dark hour half cycle (table 2). SDH activity exhibited dielrhythmicity in control animals with crests alternating with troughs. Following envenomation, fluctuations in X values were significantly high (table 1). Scorpion venom induced phase shifts in SDH activity of the tissues. The crest values of SDH in CM and the trough values of EM, CM exhibited delayed phase shift ($-\triangle\phi$) by 4 hr. while the crest of SDH in brain showed an advance phase shift ($+\triangle\phi$) by 4 hr. The crest and trough values of SDH rhythm in liver remain unchanged even after envenomation.

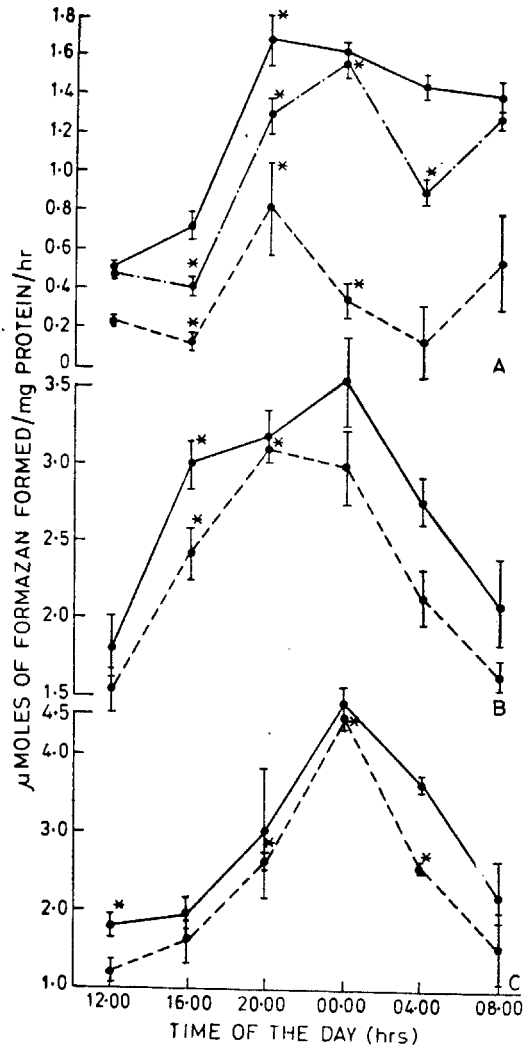

Figure 1 A–C SDH rhythm in the tissues of *Mus booduga* after envenomation

A: Muscle; *B:* Brain; *C:* Liver; _____Control; –.–.– Contralateral;———Experimental

Each value is an average of 6 individual observations

* Statistically significant ($P<0.05$—0.001)

The results represented in table 1 and figure 1, demonstrate that the venom of scorpion inhibited SDH activity in *Mus booduga*. A similar decrease in SDH activity was also reported in cockroach (Babu et al. 1971, Rajarami Reddy et al. 1980), lizard (Govardhan Reddy 1979) and Guinea pig (Vijayakumari et al.

1982) with the venom of *H. fulvipes*. The observed inhibition in SDH activity suggests decreased energy metabolism of envenomated mice. It has been found that mitochondria are morphologically damaged due to scorpion venom poisoning (Diniz et al. 1974). Since SDH is majorly mitochondrial enzyme, inhibition in enzyme activity might be due to altered structural integrity of mitochondria. Inhibition of SDH may also be due to a direct inactivation of the enzyme itself by the scorpion venom.

The computed crest (X_{max}), trough (X_{min}), amplitude *(A)* and the acrophase (ϕ) values of SDH rhythm indicate the existence of dielrhythmicity in SDH activity of *Mus booduga*. The MELs are in synchrony with the motoric activity of the animal as observed in lizards and mice (Pavankumar et al. 1979, Rajarami Reddy et al. 1982). Phase shifts of both +ve and -ve as observed in the SDH rhythm of mouse during post envenomation were reported in different physiological activities of animals under various stresses (Vijayalakshmi 1977, Sivanarayana Reddy 1980). The pattern of phase shifting was according to Brown (1973), i.e., different components appear to shift at different rates towards new equilibrium state indicating the adaptability of the animal to the imposed condition.

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Table 1 *Rhythm characteristics of SDH in control and envenomated mice*

Name of the tissue	*A*	ϕ	X_{max}	X_{min}	MEL		% change over control
					A	*B*	
MUSCLE							
Control	1.098	—106.9°	24.8	12.8	0.87	1.57	—
EM	0.238	—164.3°	21.1	09.1	0.29	0.43	70.5
CM	0.915	—103.9°	25.1	13.1	0.72	1.25	19.3
BRAIN							
Control	1.612	—154.3°	21.7	09.7	2.13	3.04	—
Experimental	1.696	—156.5°	21.5	09.5	1.73	3.76	16.05
LIVER							
Control	2.939	—111.2°	24.5	12.5	1.89	3.76	—
Experimental	2.963	—123.9°	23.7	11.7	1.39	3.24	17.99

A, Amplitude; ϕ, Acrophase; X_{max}, Computed crest; X_{min}, Computed trough; *MEL*, Mean Enzyme Level (*A*=Light hour half cycle; *B*=Dark hour half cycle)

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