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Responses of the neurosecretory cells of the terrestrial slug, *Semperula maculata* to temperature acclimation (32°c and 15°c

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ABSTRACT

Changes in the neurosecretory cell (cell A and cell B) cytology of *Semperula maculata* subjected to thermal acclimation (32°c ± 0.5°c and 15°c ± 0.5°c) for 10 days have been investigated. Of the two temperatures in which slugs are acclimated striking changes were evident in 32°c than 15°c. After acclimation treatment (15°c) there was increase in neurosecretory material and nuclear diameter in cell A and cell B. While on 32°c acclimation, nuclear diameter of the slug showed enlargement and neurosecretory material intensity was lowered in cell A and cell B. The rate of neurosecretory material synthesis was not varied in both that is in cold and warm acclimated cell A and cell B. As nuclear diameter did not showed much more differences in cell A and cell B. But there may be variation in transportation of neurosecretory material in cell A and cell B in warm acclimated and cold acclimated slug as neurosecretory material on cold acclimation accumulated whereas on warm acclimation there may be more transportation. The adaptive significance and neuroendocrine system of *Semperula maculata* is discussed in relation to temperature acclimation.

Keywords: *Semperula maculate*, neurosecretory cell, acclimation

Introduction

Acclimation refers usually to the compensatory change in an organism under maintained deviation of a single environmental factor (usually in the laboratory). If acclimation is complete a measured rate function is the same under one environmental condition as under another.

The organism has to face a variety of environmental factors like water, organic food, oxygen, carbon dioxide, light, pressure, radiation and temperature [1-3]. Temperature is considered as a critical environmental factor in the ecology of most of the organism [4-6]. The terrestrial mollusks are in constant confrontation against exogenous factor for its survival. The slugs are the most successful stylommatophoran pulmonates as far as their adaptability is concerned [7]. The physiological and biochemical changes in the unfavorable conditions have been studied by Florkin and scheer [8]. Neurosecretory phenomenon was studied by Gabe [9], Van Mol, 10-11], Antheunisse, [12] Wigdenes et al., [13]. But very scanty work is done on the neurosecretory cells and temperature.

Semperula maculata is most commonly found slug in vidarbha region and it is abundantly available in the field and garden. Now a day scenario is gradually changing. This fact provided an incentive to undertake the present investigation. This study focuses on two different acclimation temperatures in which nuclear diameter and neurosecretary material of neurosecretory cells A and B will observed. The perusal of literature indicate that the study of changes in the cell types of cerebral ganglion with respect to temperature have great importance because now a day temperature of atmosphere goes on changing. It affects on land slug which play significant role in ecosystem.

Material and Methods

Adult fully matured slugs, *Semperula maculata* were collected from the city garden Paratwada and around Paratwada city, Maharashtra, India from July to September. The temperature of the soil at the time of collection varied generally from 26°c to 28°c. Slugs were brought to the laboratory and were maintained in the glass tough containing sufficient moist soil. They were fed once in a day with plant vegetation. Slugs were acclimated at room temperature (26°c to 28°c) for 3 to 4 days. For acclimation slugs were kept inside the BOD incubator at temperature 15°c $\pm$ 0.5°c for cold acclimation for 10 days. The slugs were gradually cooled until the desired acclimatized temperature was reached. Similarly for warm acclimation slugs were kept inside the BOD incubator at 32°c $\pm$ 0.5°c for 10 days. The temperature of BOD gradually increased until the desired acclimatized temperature was reached. Every after 2days the soil in jar was replaced with moist soil already brought up to appropriate acclimation temperature. Concomitantly control slug were maintained similarly by keeping animals at a temperature (26°c to 28°c). The slugs were gently handled during experiment so that the slugs did not suffer from any psychosomatic shock. A group of five slug control as well as experimental were sacrificed and cerebral ganglion was carefully dissected out from the slugs quickly as possible and was fixed in Bouins fluid. It was then dehydrated in alcohol, cleared in xylene and embedded in wax at 57.5°c. Serial sections were cut at 8 µ in thickness and were stained with Gomoris chrome hematoxylene - Phloxin method [14]. The intensity of neurosecretory material of A cell and B cell was determined by adopting a visual arbitrary scale. Where, 1 = No NSM, 2 = Slight NSM, 3 = Considerable NSM, 4 = only perikarya loaded with NSM, 5 = Perikarya and axon loaded with NSM.

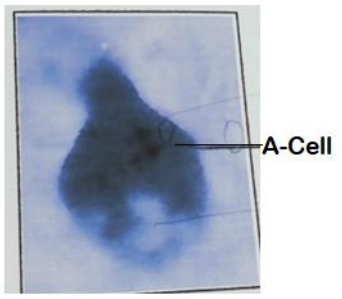
Results

The differences in nuclear diameter and neurosecretory material of cell A and cell B of Cerebral ganglion of the slug, *S. maculata* on warm and cold acclimation (32°c and 15°c) were observed.

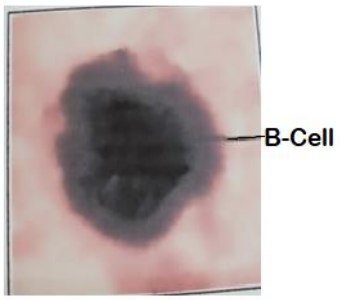
A study of the serial sections of cerebral ganglion of the warm acclimated (32°c) slug, *S. maculata* showed nuclear diameter of A cell and B cell was found to be 58.4$\pm$ 0.20 and 15.9$\pm$ 1.2 respectively. The neurosecretory intensity was (2) in both cells means they showed slight NSM. This showed that neurosecretory cells (A cell and B cell) of cerebral ganglion at 32°c had strong vacuolization with rare neurosecretory granules in the axon and in the neuropilar areas. Nuclear diameter showed enlargement and neurosecretory intensity was lowered.

Table 1: Effect of warm and cold acclimation on nuclear diameter and neurosecretory material of cell A and cell B of cerebral ganglion of the slug, *Semperula maculate* (C- Control, E-Experimental average of 5)

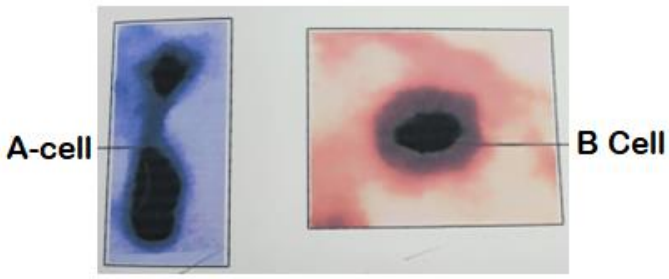
		Warm acclimation 32°c		Cold acclimation 15°c	
Cell type		Nuclear diameter in µ	Neurosecretory intensity	Nuclear diameter in µ	Neurosecretory intensity
A cell	C	58 ± 1.5	3	58 ± 1.5	3
	E	58.4 ± 0.20	2	60 ± 1.20	4
	% change	(0.69)	(-33.33)	(3.44)	(33.33)
B cell	C	15 ± 1.1	3	15 ±.1.1	3
	E	15.9 ± 1.2	2	15.8 ± 1.0	4
	% change	(6.0)	(-33.33)	(5.33)	(33.33)



A cell type of cerebral ganglion of the control slug, Semperula maculate

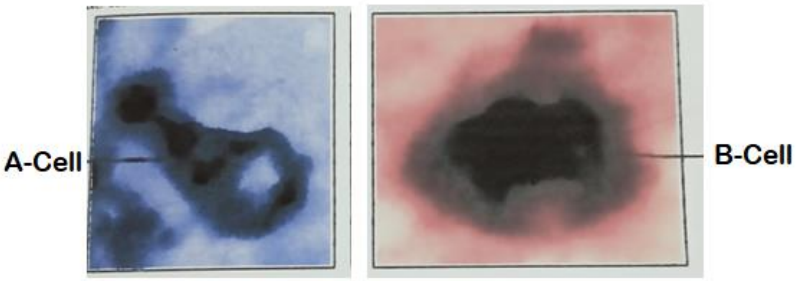


B cell type of cerebral ganglion of the control slug, Semperula maculate



Neurosecretory cell A of cerebral ganglion of cold acclimated (15^{O}C) slug , Semperula maculate

Neurosecretory cell B of cerebral ganglion of cold acclimated (15^{O}C) slug, Semperula maculata



Neurosecretory cell A of cerebral ganglion of the Warm acclimated (32^{O}C) slug, Semperula maculata

Neurosecretory cell B of cerebral ganglion of the warm acclimated (32^{O}C) slug, Semperula maculate

In cold acclimated (15°c) slug, *Semperula maculata*, nuclear diameter of A cell was measured about 60 ± 1.20 and neurosecretory intensity was found to be (4) that is perikarya loaded with NSM. The range of nuclear diameter of B cell at 15°c was about 15.8 ± 1.0 and neurosecretory intensity was found to be (4). It was found that their nuclear diameter was increased in both the cell. Likewise they were blooming with neurosecretory material.

From the table, it was found that when the slug acclimated to warm and cold temperature (32°c and 15°c) their nuclear diameter was increased in both the cells, cell A and cell B. On warm acclimation, neurosecretory material was decreased in both cell A and cell B. whereas on cold acclimation neurosecretory material was increased in both cells.

In insects, changes in the neurosecretory cells in response to thermal acclimation have been observed Ivanovic et al; [15-16]. In the present study the slug, *Semperula maculata*, A and B cells of cerebral ganglion were experienced with enlargement of nuclei on both warm and cold acclimation. In warm and cold acclimation synthesis of neurosecretory material is in same quantity as there were no marked differences in their nuclear diameter. On warm acclimation, scanty neurosecretion was spotted in perikarya and axon of A and B cells. These neurosecretory cells are extremely active and transport and release neurosecretory material probably faster than the synthesis. There by giving no or very little allowance for the accumulation of the secretory material in the perikarya and axon.

In warm and cold acclimation synthesis of neurosecretory material is same but the accumulation of neurosecretory material in A and B cells during cold acclimation may be the resultant of the cessation of the axonal transport and release.

High temperature (40°c) helped in releasing the neurosecretory material whereas the low temperature (20°c) caused the accumulation of neurosecretory material in the snail, *Cerastus moussonianus* [17]. The effect of warm acclimation on neurosecretory material of cerebral ganglion of slug, Semperula maculate is similar to that of Choudhary and Wankhade [18]

After exposing the slugs to warm and cold acclimation, it is concluded that on warm acclimation (32°c) nuclear diameter in both cells A and B was increased and on cold acclimation (15°c) neurosecretory material in A and B cell was curtailed. During warm acclimation these neurosecretory cells are extremely active and transport and release neurosecretory material probably faster than synthesis. There by giving no or very little allowance for the accumulation of the secretory material in the perikarya and axon. Scanty neurosecretory material on cold acclimation revealed that there is cessation of axonal transport and release.

Conclusion

After exposing the slugs, to cold and warm acclimation temperature (15°c and 32°c), it is concluded that nuclear diameter in both cells A and B was increased and neurosecretory material in A cell and B cell was also found to be increased. During cold acclimation there are piles of neurosecretory material in A and B cells. It is due to the cessation of the axonal transport and release neurosecretory material. Probably the rate of synthesis in these cells during cold acclimation is not substantially different on warm acclimation as there were no marked differences in their nuclear dimensions.

Conflicts of interest: The authors stated that no conflicts of interest.

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