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Effect of Ambient Temperature on the Growth of Fat Cells in Ageing *Dysdereus similis* Freeman (Pyrrhocoridae Hetroptera)

Sadhna Tamot

Department of Zoology, Sadhu Vaswani College, Bairagarh, Bhopal, (MP)

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ABSTRACT : Exposure to and rearing of the bugs at a higher temperature (30°C) since the last (5th) nymphal stage, triggered the metabolic activities in the fat cells earlier than normal, thus influencing the growth of the later i.e. size of fat cells & their nuclei. There was apparently no effect on the longevity of the bug. Exposure and rearing in a lower temperature did not influence the growth of fat cells.

Keywords : Ageing, *Dysdercus similis.*

INTRODUCTION

Aging process may be defined as those processes occurring in individuals which render them more likely to die as they grow older, either from internal or external causes. The fact that in poikilotherms an increase in temperature reduces the life span has naturally been taken as showing that the rate of ageing process, like those of chemical reactions are dependent on temperature.

Some workers such as Leob and Northrup (1917), Alpatov and Peart (1929), Alpatov (1930), Maynard Smith (1961) etc. have studied the effect of temperature on aging of Drosophila, where as Sharma et al (1979) have observed temperature dependent longevity of *Zabrotes subfaciatus* and Jit and Sharma (1982), the life span of *Zabrotes paravittiger*. However the most of these studies relate to effect on the total life span and egg laying. According to Sohal et al (1985) the decrease in the life span at higher temperature is believed to be due to an increase in the metabolic activity. Various insects are known to be able to become acclimatized to different temperature, as a result of which the position of their thermal death points may be altered. (Mellanby,1954). Taking the above into consideration and since insect fat body is the main tissue for intermediary metabolism - a process the rate of which must affect the aging of an organism; it was proposed to explore the effect of temperature on the growth and function of the fat body of the red cotton bug *Dysdercus similis* with reference to its senescence. Some notable work on different aspects of *D. similis* was reported by Rao et al (1983), Pathak (1980), Sita *et al.* (1983), Kumar & Thakur (1989), Bhide (1986,1991), Gupta (2009). The present paper is a part of the work and deals with effect of ambient temperature on the growth of fat cells of the bug.

MATERIAL AND METHODS

The red cotton bug *Dysdercus similis* was collected from its host plants Gossipium and hibiscus. They were then reared in the laboratory at normal temperature (27-29°C) on moist cotton seeds in glass fronted cages. To observe the effect of temperature on their metabolism, a group of bugs were reared at higher temperature (37°C) from the 5th nymphal stage on words. Another group was simultaneously reared at low temperature 20°C. The fat body was dissected out from adult females and males reared at normal as well as elevated temperature at various periods of the full life span. The dissected material was fixed in Cornoy's solution. Paraffin blocks were prepared and cut at 6µ thickness. The sections were stained by P/MG method of Jorden and Baker as given by Pearse (1960) and size of fat cells and their nuclei were measured by using an accular micro meter at X 600. Since cells and nuclei of a particular stage of the insect have areas which vary very slightly, a single average value has been used in all the tables. The average values for each size was obtained from the mean of the areas of 30-35 cells from every stage of the insects.

RESULT AND DISCUSSION

The fat cells of *D. similis* are oval to rectangular in shape and the nuclei are almost round. Under normal ambient temperature, the fat cell size and nuclei size increased or decreased as shown in table 1 and 3, According to synthesis/accumulation and release, respectively of metabolites upto about 12 days in both the sexes. Then the nuclear size decreased in older bugs. After 15 days the fat cells became distorted and remained as such till death.

Exposing to, and rearing the insects at a higher temperature seemed to accelerate the metabolic activities of the insects. The structure of the fat body of temperature treated young adult e.g. four and eight day old looked like that of a twelve to fourteen days old bug. Similarly fat cells of a twelve day old bug looked like those of eighteen days old adult. The cells and nuclei of temperature treated individuals were bigger in size than the normal adults as shown in table 2 and 4. P/MG staining also showed very intense reaction for nucleic acids in the fat cells. At 20°C there was practically no change in the size of the fat cells and nucleic or in the deposition of nucleic acids.

Table 1: Changes in the average diameter of fat cells and nucleus of female *D. similis* with ageing at normal temperature.

Age of insect	*Cell*		*Nucleus*	
	Average diameter in 'μ'	*Standard diameter*	*Average diameter in 'μ'*	*Standard diameter*
Newly emerged female	7.54	0.7353	4.16	0.0
Four day old female	7.02	0.7353	5.07	0.3670
Eight day old female	7.02	0.7353	4.94	0.4814
Twelve day old female	7.28	0.9628	5.20	0.7861
Fourteen day old female	7.41	0.6665	4.94	0.7353

Table 2: Changes in the average diameter of fat cells and nucleus of female *D. similis* with ageing at elevated temperature.

Age of insect	*Cell*		*Nucleus*	
	Average diameter in 'μ'	*Standard diameter*	*Average diameter in 'μ'*	*Standard diameter*
Newly emerged female	8.45	0.6665	4.29	0.3676
Four day old female	8.19	0.3676	5.20	0.0
Eight day old female	8.06	0.4814	5.20	0.0
Twelve day old female	8.32	0.9628	5.33	0.8670
Fourteen day old female	8.06	0.7353	5.46	0.4814

Table 3: Changes in the average diameter of fat cells and nucleus of male *D. similis* with ageing at normal temperature.

Age of insect	*Cell*		*Nucleus*	
	Average diameter in 'μ'	*Standard diameter*	*Average diameter in 'μ'*	*Standard diameter*
Newly emerged male	7.80	0.7861	4.55	0.5382
Four day old male	6.50	0.9218	3.77	0.5382
Eight day old male	6.63	0.7757	3.9	0.4842
Twelve day old male	7.28	0.9628	4.42	0.4814
Fourteen day old male	6.89	0.5382	4.55	0.5382

Table 4. Changes in the average diameter of fat cells and nucleus of male *D. similis* with ageing at elevated temperature.

Age of insect	*Cell*		*Nucleus*	
	Average diameter in 'μ'	*Standard diameter*	*Average diameter in 'μ'*	*Standard diameter*
Newly emerged male	8.58	0.4814	4.55	0.5582
Four day old male	7.80	0.5559	4.22	0.4814
Eight day old male	7.80	0.5559	4.26	0.1897
Twelve day old male	7.93	0.5582	4.55	0.5382
Fourteen day old male	7.67	0.5382	4.68	0.5559

In the present work, effects of higher as well as lower temperature than the normal environmental temperature have been investigated on the growth of fat bodies of female and male *D. similis* in relation to their ageing. Although growth is manifested to different extent in the cell and its components. In the present study growth has been simply defined as an increase in the cell size as in Drosophila (Butter worth, 1967) and Poekilocrous pictus (Banerjee,1983). Growth may be due to enormous deposition of metabolites or increase in the background cytoplasm. The present study revealed that the rate of accumulation is more and occurs earlier in insects reared at 37°C from 5th nymphal stage onwards, than in the fat body of normal individual. In other words at higher temperature the synthetic/metabolic activity is accelerated. Accumulation of the metabolites synthesized at higher rate at elevated temperature causes hypertrophy of fat cells and nuclei which show increased sizes under the microscope than normal cells and nuclei. Thus a higher ambient temperature definitely accelerates the growth of fat body in *Dysdercus similis*. Since ageing fat cells of normal individuals show accumulation of metabolites, it can be said that higher ambient temperature accelerates the aging process in this bug, when it is reared under that temperature since its 5th nymphal stage. The total life span, as shown by the present work, remains un-altered in this bug, when reared at higher temperature. According to Leob *et al.* (1917) and Alpatov (1929), the life span of *Drosophila* decreases with the increasing temperature, whereas according to Maynard Smith (1961) rate of ageing is roughly independent of the temperature, at least from 15°C to 30°C. The life span as well as the growth of fat cells remains almost unaffected in *Dysdercus similis* by rearing them at a lower temperature (20°C) as found in the present study. In females the first egg laying is slightly accelerated but the second egg laying remains unaffected by elevated temperature. Hypertrophid fat cells with accumulation of metabolites in them are signs of inactivity of these cells (Banerjee, 1977, 1983). It is speculated that accumulation in and inactivity of the fat cells may cause an early onset of senescence in *Dysdercus similis*.

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