THE EFFECT OF PREVIOUS EXPOSURE TO HIGH TEMPERATURE ON THE HEMOLYSIS TIMES AND OXYGEN CONSUMPTION OF CUNNER ERYTHROCYTES*

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One of the authors (F.R.H.) has conducted a series of experiments to determine what relationship, if any, exists between the metabolic activity of a cell and the maintenance of the selective permeability properties of its membrane (See Hunter, 1936, for the first paper in this series). One method used to attack this general problem was described by Hunter and Pahigian (1940). In their experiments, chicken erythrocytes were exposed to high temperatures for a period of time and then returned to 37°C and respiration and permeability were measured.

In the present investigation the erythrocytes of the cunner (*Tautogolabrus adspersus*) were subjected to a similar heat treatment and then respiration and times for hemolysis were measured. These data are now presented because they are considerably different from those previously reported.

Blood, obtained either directly from the heart or by cutting through the gills, was defibrinated. In order to obtain a sufficient number of cells for a single experiment, the blood from several individuals was mixed. It was placed in small stoppered vials in a water bath for one hour, unless otherwise indicated, at the experimental temperature. It was then allowed to return to a temperature of 25°C. Oxygen-consumption measurements were made in the usual manner using a Barcroft-Warburg apparatus (Dixon 1934). Hemolysis times were measured by determining the time required for 80 percent of the cells to hemolyze, while cell counts were made using a standard counting chamber.

Oxygen-consumption measurements are presented in Table I and Fig. I. It can be seen that subjecting the cells to temperatures between 30° and 40° C for an hour and 40° for 10 minutes increased the rate of oxygen consumption after the cells had been returned to 25°C. Temperatures above 40° resulted in marked changes in both the color and consistency of the blood, which are associated with a decrease in the rate of oxygen consumption.

The effect of this temperature treatment on the time for hemolysis in several nonelectrolytes is indicated in Table II. In general there is a decrease in time for hemolysis.

It is obvious that exposure to temperatures considerably above normal may affect a cell in a variety of ways, which makes a complete analysis of such fragmentary data impossible. However, the difference between the behavior of chicken and cunner erythrocytes might be interpreted as supporting the conclusion previously reported.

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TABLE I

Effect of previous exposure to high temperature on the oxygen consumption of cunner erythrocytes

Cu mm O_2 per billion cells per hour						Percent change
25° (control)	43°	40°	40° (10 min.)	35°	30°	
7.3	4.1					—43.8
7.3	2.1					—71-3
7.2	2.6					—63.9
5.9		9.6				+62.7
6.4		8.0				+25.0
7.2		10.5				+45.8
4.3		7.6				+76.7
7.5		10.8				+44.0
11.0		10.4				— 5.5
11.2		13.0				+16.1
7.3			12.8			+75.3
11.0			10.9			— 0.9
11.2			14.4			+28.5
12.2			12.7			+ 4.1
7.3				12.1		+65.7
11.9				14.1		+18.5
4.3					5.4	+25.6
7.5					8.7	+16.0
12.2					12.4	+ 1.6

TABLE II

Effect of previous exposure to high temperature on the hemolysis of cunner erythrocytes

Substance	Average time in seconds for 80 percent hemolysis						Percent
	25° Control	43°	40°	40° (10 Min.)	35°	30°	Change
Ethylene glycol	8.0		6.7				—16.2
	7.2			6.3			—12.5
	6.9				6.3		— 8.7
	7.7					6.9	—10.4
	8.4	7.6					— 9.5
Diethylene glycol	13.6		11.3				—16.9
	12.7			10.5			—17.3
	12.4				9.5		—23.4
	13.3					12.7	— 4.5
	12.7	9.8					—22.8
Triethylene glycol	46.5		24.2				—47.9
	25.6			22.2			—13.3
	25.3				22.6		—10.7
	54.8					49.2	—10.2
Glycerol	262		202				—22.9
	250			201			—19.6
	247				179		—27.1
	267					250	— 6.4
	240	77					—67.9
Urea	313		221				—29.4
	234			191			—18.4
	225				180		—20.0
	287					235	—18.1
	230	47					—79.5
Thiourea	61.9		51.4				—17.0
	55.5			46.0			—17.1
	53.0				42.9		—19.1
	60.6					53.2	—12.2
Malonamide	1266		1012				—20.1
	1561			1194			—23.5
	1292				1134		—12.3
	1269					1154	— 9.7

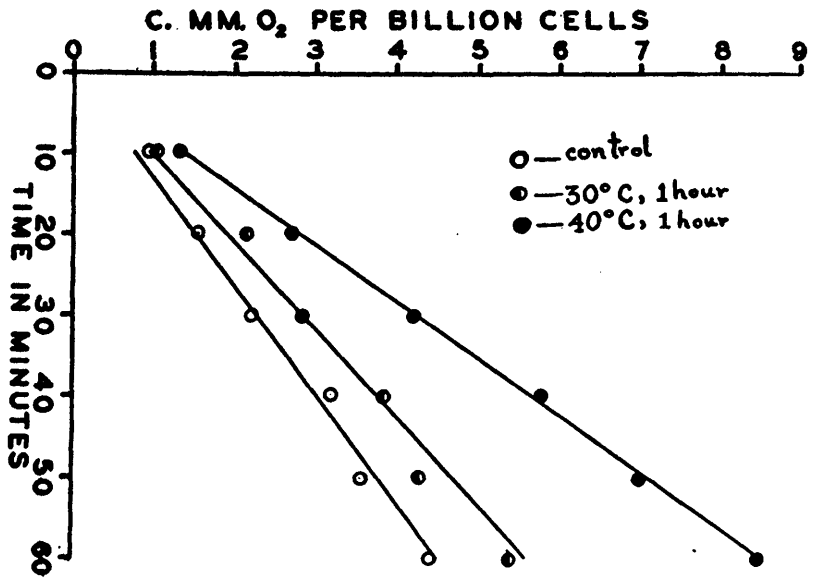

Fig. 1—The effect of previous exposure to high temperature on the oxygen consumption of cunner erythrocytes.

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