Life Span of the Marmot Erythrocyte

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CYTOLOGIC STUDIES of the peripheral blood and histologic studies of the marrow of the hibernating marmot show a well sustained erythrocyte count with little evidence of erythropoietic activity.\(^1\)\(^2\) This phenomenon may be due to a prolongation of the life span of the erythrocyte. The present experiment was designed to determine the effects of low environmental temperature and hibernation on the life span of the marmot erythrocyte.

METHOD

Carbon 14 labeled glycine has been shown to be a satisfactory tool for the measurement of the life span of the erythrocyte in the dog\(^3\) and the rat.\(^4\) Since we were primarily interested in the difference in the life span under various conditions, a simplified technic was employed.

Each of 4 marmots was given an intraperitoneal injection of 36 mcg. per Kg. of body weight of C\(^{14}\) as glycine-2-C\(^{14}\). The animals were kept at room temperature for one week to insure absorption of the glycine and then 3 were transferred to the cold room at 4.5 C. The animals in the cold room were allowed to fast for the first four weeks to aid in inducing hibernation but cracked corn was supplied thereafter. Water was kept in the cages at all times.

Samples of less than 1 ml. of blood were taken at intervals after injection by heart puncture. The heparinized blood was centrifuged, the supernatant plasma discarded and the cells washed three times with saline. The cell suspension was then transferred to a calibrated Wintrobe tube and the cells centrifuged to a constant volume.

The exact volume of red cells was determined and the cells hemolyzed with 10 volumes of distilled water. An aliquot containing an equivalent of 0.1 ml. of packed erythrocytes was transferred to a 1 inch copper planchet and dried. The activity of the samples was measured in a gas flow proportional counter. At least 2 aliquots were counted for each blood specimen and each sample was counted for 50 minutes or 10,000 counts.

RESULTS

The activity of the samples as a function of time is plotted in figure 1. Marmot A was kept at room temperature throughout the experiment. Marmot B was removed from the cold room on the forty-second day after injection without any evidence of hibernation. Marmot C was returned to room temperature on the eighty-ninth day after injection without having shown any evidence of hibernation. Marmot D was observed to hibernate from the forty-second to the sixty-sixth day, but was awake when returned to room temperature on the eighty-ninth day.

The rising and plateau portions of the curves have been shown as straight lines to simplify the figure and facilitate the analysis of the curves by the method of Shemin and Rittenberg.\(^5\) The results of this analysis are shown in table 1.

DISCUSSION

The mean life span of the erythrocyte is increased by low environmental temperatures but there appears to be a limit to this increase. This is shown by the

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fall in the activity of the erythrocytes of Marmot C prior to being transferred to room temperature. The hibernating marmot does not show this limitation in the duration of this experiment.

The low level of metabolism and the low body temperature associated with hibernation seem to be the most relevant factors which may cause an increase in

![Graph](image)

**FIG. 1.—Radioactivity of erythrocytes as a function of time.**

**TABLE 1.—Life Span of Marmot Erythrocytes**

<table>
<thead>
<tr>
<th>Marmot</th>
<th>Days in cold room</th>
<th>Period of hibernation</th>
<th>Mean life span of erythrocyte in days*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>0</td>
<td>36 ± 2</td>
</tr>
<tr>
<td>B</td>
<td>35</td>
<td>0</td>
<td>65 ± 6</td>
</tr>
<tr>
<td>C</td>
<td>82</td>
<td>0</td>
<td>95 ± 6</td>
</tr>
<tr>
<td>D</td>
<td>82</td>
<td>42-66th day</td>
<td>112 ± 7</td>
</tr>
</tbody>
</table>

* Measured as 50 percent destruction of the cells carrying C14.

the life span of the erythrocytes in the hibernating marmot. Benedict and Lee did not observe low rectal temperatures or low metabolic rates among their non-hibernators kept in the cold, so these factors cannot be held responsible for the prolonged life of the red cells in the non-hibernating marmots. It is apparent that the conditions which tend to induce hibernation, and the state of hibernation itself, effect a prolongation of the life span of the red cells.
REFERENCES

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