THE CONCENTRATIONS OF LACTIC ACID IN BLOOD AND LIVER OF RABBITS

BY PHYLLIS A. BOTT AND D. WRIGHT WILSON

(From the Department of Physiological Chemistry, School of Medicine, University of Pennsylvania, Philadelphia)

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In experiments described in the previous paper we observed that the concentrations of lactic acid in livers of well fed animals (generally 70 to 150 mg. per cent) were higher than those of fasting animals (20 to 50 mg. per cent). Cori (1) noted a similar variation in mice. As some struggling occurred when the rabbits were tied down and anesthetized, it was assumed that the high concentration of lactic acid in the liver might be associated with an increased lactic acid concentration of blood resulting from heightened lactic acid production. It is known that the liver removes lactic acid from blood after exercise. We therefore thought it worth while to study the relation between the concentrations of lactic acid in blood and liver of well fed and fasting rabbits after exercise.

The animals were tied on an animal board, sodium amytal was given intraperitoneally, blood samples were taken from an ear vein, and, when anesthesia was complete, liver samples were obtained. Rabbits are so excitable that the amount of muscle activity which took place was probably far greater than would have been encountered with other common laboratory animals.

About 2.5 cc. of blood were drawn, usually by nicking the ear vein, into a paraffined test-tube immersed in ice water. 2 cc. were quickly pipetted into a flask containing 10 cc. of water. The usual Schenk and Van Slyke precipitations were made and lactic acid determined in the final filtrate.

The samples of liver were dropped into liquid air immediately after removal from the animal and powdered in an iron mortar. From 2 to 3 gm. were weighed (in the cold room) into flasks containing 15 cc. of Ringer’s solution and 3 cc. of 8 per cent HCl.
After standing 1 hour in the cold room 12 cc. of 8 per cent HCl and 30 cc. of 5 per cent HgCl₂ were added. The solutions were filtered

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Condition of animal</th>
<th>Position during anesthesia</th>
<th>Time after injection of amytal (min.)</th>
<th>Blood lactic acid (mg. per 100 cc.)</th>
<th>Liver lactic acid (mg. per 100 gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fed</td>
<td>Tied on board</td>
<td>16</td>
<td>81</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>18</td>
<td>138</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>&quot;</td>
<td>&quot;</td>
<td>0</td>
<td>164</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>&quot;</td>
<td>&quot;</td>
<td>8</td>
<td>25</td>
<td>37</td>
</tr>
<tr>
<td>5</td>
<td>&quot;</td>
<td>&quot;</td>
<td>7</td>
<td>25</td>
<td>27</td>
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<tr>
<td>6</td>
<td>&quot;</td>
<td>&quot;</td>
<td>6</td>
<td>27</td>
<td>36</td>
</tr>
<tr>
<td>7</td>
<td>&quot;</td>
<td>&quot;</td>
<td>7</td>
<td>27</td>
<td>45</td>
</tr>
<tr>
<td>8</td>
<td>&quot;</td>
<td>Upright in cage</td>
<td>33</td>
<td>33</td>
<td>45</td>
</tr>
<tr>
<td>9</td>
<td>&quot;</td>
<td>&quot;</td>
<td>33</td>
<td>33</td>
<td>74</td>
</tr>
<tr>
<td>10</td>
<td>Fasted 6 days</td>
<td>Tied on board</td>
<td>33</td>
<td>33</td>
<td>40</td>
</tr>
<tr>
<td>11</td>
<td>&quot; 5 &quot;</td>
<td>&quot;</td>
<td>33</td>
<td>33</td>
<td>44</td>
</tr>
<tr>
<td>12</td>
<td>&quot; 8 &quot;</td>
<td>&quot;</td>
<td>33</td>
<td>33</td>
<td>44</td>
</tr>
</tbody>
</table>

The data for the concentrations of lactic acid in blood and liver
are given in Table I. It is evident that the concentration of lactic acid was raised to a high level in the blood of most of the well fed animals. The blood samples taken early in the experiments from three fasting animals showed smaller accumulations of lactic acid than the average of the well fed animals. Two of the three fasting animals had especially low concentrations of blood lactic acid.

The most obvious explanation for the difference in levels of blood lactic acid between the two groups of animals is that the fasting animals were less active than the well fed animals and therefore formed less lactic acid. However, we could observe little or no difference in the amount of muscle activity between the two groups of animals.

The animals of Experiments 8 and 9, which were well fed, were given sodium amytal intraperitoneally, with as little disturbance as possible, and were allowed to sit in the cage until anesthetized. Then samples of blood and liver were taken for analysis. As both animals had low concentrations of lactic acid in blood and liver, it is concluded that muscle activity due to excitement was the cause for the high concentrations of lactic acid in the blood of the other well fed animals.

Samples of liver were taken from all animals as soon as anesthesia was sufficiently deep. It is significant that in all instances the concentration of lactic acid in liver was less than it was in blood. In a number of experiments the differences were considerable, especially when the blood lactic acid was high. Experiment 3 shows that the differences were not caused by a lag in the accumulation of lactic acid in liver due to slow diffusion from the blood. In this experiment the concentration of lactic acid in liver decreased as the concentration in the blood decreased and the concentration in liver continued to be far below that in blood. The differences are much greater than could be explained on the basis of the different water contents of tissue and blood plasma.

Glycogen increases in liver after administration of lactic acid (2). By studying the blood going to and from the liver it has been demonstrated that the liver takes up lactic acid from blood after exercise (3, 4). Presumably it is converted into glycogen. Our own observations show that lactic acid does not accumulate to any great extent in the liver when it disappears from the blood after exercise, the lactic acid concentrations in the liver remaining
considerably below the blood levels. Therefore it would appear that the synthetic processes in the liver are capable of forming glycogen from lactic acid with considerable rapidity.

**SUMMARY**

The concentration of lactic acid in the blood of well fed rabbits may rise to very high values following moderate struggling and anesthetizing with amyntal. The rise is not so great in fasting animals.

The concentration of lactic acid in liver rises and falls with changes in the blood but is usually far below the blood level.

**BIBLIOGRAPHY**

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