Changes of Blood Glucose Level before, during and after Oviposition in the Domestic Fowl

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In mammals, neurohypophysial hormones influence the contractility of certain smooth muscles and play a physiological role in the regulation of the metabolism of water. They may also produce hyperglycemia\(^1\),\(^2\), though the physiological significance of this response has not been known yet. A hyperglycemic effect has been shown when arginine vasotocin was injected into lampreys and toads\(^3\),\(^4\) and when oxytocin or vasotocin was given intravenously to chicken\(^5\),\(^6\). It has not been known, however, whether endogenous neurohypophysial hormones, which would be released at oviposition in the laying hen, show a hyperglycemic effect like oxytocic substances have. The present experiment was undertaken to investigate the change of blood glucose level before, during and after oviposition in the laying hen. The blood glucose level of the hen administered with oxytocin was also determined.

Materials and Methods

Single-Comb White Leghorns weighing about 1.3 kg (1 year of age) were used in this experiment. They were starved for 18 hours before the estimated time of oviposition or injection of oxytocin and during the experimental period. One unit of oxytocin (0.2 ml of Atonin, Teikoku Zoki) was injected intravenously at 2 to 4 hours after oviposition. Blood samples were taken from the wing vein before, during and at 10, 30 and 60 minutes after oviposition with a heparinized syringe. In case of oxytocin administration, samples were obtained before and at 5, 10, 30 and 60 minutes after injection. Blood sample was transferred to a cold test tube and then centrifuged for 10 minutes at 3,000 r.p.m. Glucose in 0.1 ml of plasma was determined immediately by the method of Huggett and Nixon\(^7\).

Results and Discussion

Fasting was conducted to eliminate the influence of feed and to stabilize the blood glucose level at a lower plateau.

The change of the level of blood glucose before, during and after oviposition is shown in Table 1 and Figure 1. The maximal increase against before-oviposition-level occurred at 30 minutes after oviposition. The difference was significant (P < 0.01) by t-test. After 60 minutes, the elevated glucose level tended to return to the before-oviposition-level.

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Changes of blood glucose level

Table 1. Changes of the glucose level before, during and after oviposition

<table>
<thead>
<tr>
<th>No. of chickens</th>
<th>Item</th>
<th>2 to 4 hours before oviposition</th>
<th>During oviposition</th>
<th>After oviposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Blood glucose level (mg%)</td>
<td>121.4±2.7</td>
<td>124.0±2.6</td>
<td>130.2±4.5</td>
</tr>
<tr>
<td></td>
<td>Increase in percentage against before-oviposition-level</td>
<td>100</td>
<td>102.1</td>
<td>107.2</td>
</tr>
</tbody>
</table>

The results are given as mean ± S.E.

**: Significant difference from before-oviposition-level (P<0.01).

Table 2. The effect of oxytocin (1 U/hen) on the blood glucose level in the hen

<table>
<thead>
<tr>
<th>No. of chickens</th>
<th>Item</th>
<th>0.5 to 1 hour before injection</th>
<th>After injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Blood glucose level (mg%)</td>
<td>114.5±6.0</td>
<td>114.6±5.9</td>
</tr>
<tr>
<td></td>
<td>Increase in percentage against before-injection-level</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The results are given as mean ± S.E.

**: Significant difference from before-injection-level (P<0.01).

![Fig. 1. The change of blood glucose level after oviposition or oxytocin injection. B: before oviposition or injection O: during oviposition or time of injection.](image)

The hyperglycemic effect of oxytocin is shown in Table 2 and Figure 1. Oxytocin was injected at 3 to 4 hours after oviposition in order to eliminate the effect of endogenous oxytocic substances released at oviposition. When one unit of oxytocin was administered, a maximal and significant increase in the level of blood glucose occurred at 30 minutes after injection, and the value after 60 minutes was also different significantly from before-injection-level.
The change of increasing pattern of glucose level after oviposition was similar to the change following the injection of oxytocin (Fig. 1). In case of the laying hen, however, significant increase in blood glucose occurred only 30 minutes after oviposition, while the glucose of the hen injected oxytocin was maintained at significant high levels from 30 to 60 minutes after injection. Difference of the change of blood glucose level between the laying hen and the oxytocin injected hen may depend on the fact that the dosage of oxytocin used in this experiment (1 U/hen) was considerably greater than the amount of endogenous neurohypophysial hormones released at oviposition, 2,000-8,000 µU/ml plasma\(^8,9\).

These results would suggest the sensitive reactivity of oxytocin on blood glucose and confirm the release of neurohypophysial hormones at oviposition.

Mechanisms of elevation of blood glucose level with oxytocin has not been well known. In rabbits, a hyperglycemia following the administration of oxytocin was assumed to be mediated by the adrenal gland\(^10\).

Further studies are required to elucidate the mechanism.

References

2) MIRSKY, I.A.: Endocrinology. 73, 613, 1963.