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Effect of Exposure to a Short-Duration Sound on the Stress Response of Chickens

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SUMMARY. Chickens were subjected to the sound produced by banging on a metal pail (104 decibels) for 30 seconds. Heterophil/lymphocyte (H/L) ratios began to rise 18 hours later, reaching their maximum value (0.62) in 20 hours and returning to pre-stress values after 30 hours. Neither resistance to Escherichia coli challenge infection nor antibody response were altered.

RESUMEN. Nota de Investigación—Efecto de la exposición a un sonido de corta duración sobre la respuesta al stress o tensión de los pollos.

Se sometieron pollos a la acción de un sonido producido golpeando un balde de metal (104 decibeles) durante 30 segundos. La proporción heterófilos:linfocitos empezó a aumentar 18 horas más tarde, alcanzando su máximo valor (0.62) en 20 horas, retornando a los valores pre stress después de 30 horas. No se alteró la resistencia al desafío con Escherichia coli ni la repuesta de anticuerpos.

It has been determined that the exposure of chickens to environmental stresses results in increased resistance to Escherichia coli challenge infection and a decreased antibody response (1). However, it has not been determined how long it takes for a measurable stress response to occur. In one study (4), resistance to E. coli challenge infection and reduction in antibody responsiveness occurred 24 hours after chickens that had not previously encountered each other were mixed together. In another study (5), chickens that were fasted for 48 hours showed a stress response.

The purpose of the present study was to determine whether short exposure to a loud sound induces a stress response in chickens.

MATERIALS AND METHODS

Chickens. Two hundred four chickens were obtained from a line of white leghorns that had been selected for a high antibody (HA) response to sheep erythrocytes (6). Following a 4-week brooding period, chickens were housed in groups of eight to 10 in modified Horsfall-Bauer-type cages during the experimental period (4 to 8 weeks of age). Special efforts were made to protect the birds from environmental stressors. Chickens were kept in an isolated room (so that other chickens would not be affected by the sound), which was entered once daily by workers who were careful to treat the chickens gently and not make quick movements or loud sounds (feed and trash cans were plastic).

Measurement of stress. The heterophil/lymphocyte (H/L) ratio was employed for the determination of the chickens’ stress response (3). Three replicates were used. Numbers of heterophils and lymphocytes were determined by the hemocytometer method (2).

Measurement of antibody responsiveness. Chickens were intravenously inoculated with 0.1 ml of a 0.25% suspension of sheep erythrocytes. Plasma was collected for antibody determination 6 days later. Titers were determined by the microtiter method.

Escherichia coli challenge infection. Bacteria belonging to E. coli serotype O1-K1 were grown in tryptose broth until the density to the culture reached that of a No. 1 McFarland tube. The culture was chilled, and 0.1 ml of a 10⁶ dilution containing 10⁸ bacteria was inoculated into the left lesser abdominal air sac of each chicken. Mortality was recorded, and the incidence of pericarditis was determined 3 days after challenge.
Table 1. Effect of a 30-second exposure to a loud sound (104 decibels) on heterophil/lymphocyte ratios, antibody response to sheep erythrocytes, and response to *E. coli* challenge infection.

<table>
<thead>
<tr>
<th>Hours after exposure to sound</th>
<th>Number of chickens</th>
<th>H/L ratios</th>
<th>Antibody titers</th>
<th><em>E. coli</em> challenge; death or pericarditis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26</td>
<td>0.27a</td>
<td>12.0</td>
<td>11/16a (69%)</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>0.29a</td>
<td>11.4</td>
<td>10/17 (59%)</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
<td>0.25a</td>
<td>11.3</td>
<td>13/18 (72%)</td>
</tr>
<tr>
<td>18</td>
<td>24</td>
<td>0.41b</td>
<td>not done</td>
<td>12/16 (75%)</td>
</tr>
<tr>
<td>20</td>
<td>26</td>
<td>0.62c</td>
<td>11.4</td>
<td>10/17 (59%)</td>
</tr>
<tr>
<td>22</td>
<td>24</td>
<td>0.56c</td>
<td>not done</td>
<td>9/16 (56%)</td>
</tr>
<tr>
<td>25</td>
<td>24</td>
<td>0.42b</td>
<td>12.9</td>
<td>5/9 (56%)</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td>0.25a</td>
<td>11.8</td>
<td>5/8 (63%)</td>
</tr>
<tr>
<td>39</td>
<td>18</td>
<td>0.27a</td>
<td>12.0</td>
<td>5/9 (56%)</td>
</tr>
</tbody>
</table>

*a*Means within a column followed by different lower-case letters are significantly different (*P* < 0.05).

*b*Number affected number challenged.

After a 2-week period of adaptation to the experimental cages, chickens were exposed to the sound produced by the banging of a metal bucket near their cages for 30 seconds. Decibel levels in the room were determined with a Brueel & Kjaer Type 2231 Modular Precision Sound Level Meter. The pre-stress decibel value in the room was 70, and during the stressing period it rose to 104. The pre-stress decibel level of 70 was caused by fans and chicken vocalizations that were not absorbed by the tile walls. Values were on a linear scale with no weighting. The chickens were not exposed to unusual or loud sounds either before or after this event.

At certain intervals afterward (Table 1) blood was collected from the brachial vein from a different group of eight to 10 chickens for the determination of H/L ratios. This experimental procedure was replicated three times. At intervals (Table 1) during two of these replications, chickens were inoculated with *E. coli*. During one of these replications, the chickens were inoculated with sheep erythrocytes.

Statistical analysis of the data. Differences between H/L ratios and antibody titers were determined by one-way analysis of variance. Differences between incidences of pericarditis and death were determined by a 2 × 2 contingency table.

RESULTS

At the time of exposure to the sound stress, the mean H/L ratio was 0.27. By 18 hours (Table 1) after being exposed to the unusual sound, H/L ratios began to rise, reaching their maximum mean level (0.62) (replicate values were 0.61, 0.63, and 0.65) at 20 hours and returning to pre-stress values by 30 hours (*F* with 8 and 197 degrees of freedom = 91.87, *P* < 0.001). Exposure to the loud sound did not significantly affect antibody response to sheep erythrocytes (*F* with 6 and 48 degrees of freedom = 0.57) or their response to *E. coli* challenge infection (*χ^2^ = 1.25*).

DISCUSSION

In a previous study in this laboratory, when chickens were stressed by fasting, significant increases of H/L ratios (1.04) occurred 48 hours after the onset of fasting and continued for more than 72 hours (1). In another study, employing social stress, a significant stress response occurred at 24 hours (4). From these and other experiments, it was difficult to determine how quickly the stress response could occur and decline. It seemed necessary to employ a stressor of known onset and duration. Exposure to a loud unfamiliar sound was chosen. In addition, sound as a stressor does not harm chickens. This experiment indicates that it requires about 18 hours after chickens are exposed to a stressful event for a H/L ratio response to occur and that pre-stress values can be observed after 30 hours. Pre-challenge H/L ratios of 0.63 suggest that the chickens should have had increased resistance to the *E. coli* challenge infection (3) and should have had a reduced antibody response (1). The short duration of the stress response may have been responsible for the failure of these effects to be manifested in this experiment.
REFERENCES


