Mitotic Activity in the Inbred and Hybrid Quail Embryos

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In the previous paper5), marked retardation in embryonic development and decrease in embryonic weight were found in the inbred lines, while restoration of embryonic development and embryonic weight was observed in crosses between inbred lines of Japanese quail.

It is well known2–4,10) that cell number increases during morphogenesis of the early chick embryos and that a highly positive correlation is found between the early embryonic development and cell number. Furthermore, mitotic activity such as the number of mitotic cells and mitotic index4,8,11) is used as an indication of cell increase in relation to the rate of embryonic development.

However, there is very little published information on the relationship between embryonic development and mitotic activity of quail embryos.

This study was undertaken to investigate the mitotic activity in the inbred and hybrid quail embryos.

Materials and Methods

The Japanese quail used in this study consisted of inbred lines (F=59.4%), crossbreds obtained by crossing between inbred lines (F=50.0%) and a randombred population as described in our previous report5). The number of pair-matings used in the inbred lines, crossbreds and in randombred population were 38, 34 and 40, respectively.

The quail were kept under 14 hours light per day and fed freely with a diet containing 24% protein. The eggs for this study were collected and incubated for 48 hours at 38.2°C. At the end of the incubation, embryos were removed from eggs and the somite number was microscopically determined. Embryos were fixed in Bouin’s fluid, embedded in paraffin, sectioned at 10 μ and stained with Mayer’s hematoxylin and eosin.

The number of mitotic cells and total number of cells were examined in embryonic tissues...
Table 1. Number of somites, mitotic cells and mitotic index in various tissues of 48-hour-old embryos.

<table>
<thead>
<tr>
<th>Mating group</th>
<th>No. of embryos</th>
<th>No. of somites</th>
<th>Number of mitotic cells</th>
<th>Fore-brain</th>
<th>Hind-brain</th>
<th>Neural tube</th>
<th>Somite</th>
<th>Notochord</th>
<th>Blood corpuscles, blood isles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbred lines</td>
<td>25</td>
<td>16.0±0.9&lt;sup&gt;a&lt;/sup&gt; 15.1±2.2&lt;sup&gt;a&lt;/sup&gt; 9.9±1.1&lt;sup&gt;b&lt;/sup&gt; 6.5±0.6&lt;sup&gt;a&lt;/sup&gt; 8.2±0.7&lt;sup&gt;a&lt;/sup&gt; 0.4±0.1&lt;sup&gt;a&lt;/sup&gt; 10.8±1.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(2.88)&lt;sup&gt;a&lt;/sup&gt; 3.68&lt;sup&gt;a&lt;/sup&gt; 4.14&lt;sup&gt;a&lt;/sup&gt; 3.26&lt;sup&gt;a&lt;/sup&gt; 2.62&lt;sup&gt;a&lt;/sup&gt; 4.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Crossbreds</td>
<td>25</td>
<td>21.4±0.4&lt;sup&gt;b&lt;/sup&gt; 25.0±1.4&lt;sup&gt;b&lt;/sup&gt; 16.2±1.0&lt;sup&gt;b&lt;/sup&gt; 10.3±0.6&lt;sup&gt;b&lt;/sup&gt; 15.5±0.9&lt;sup&gt;b&lt;/sup&gt; 0.5±0.1&lt;sup&gt;b&lt;/sup&gt; 23.3±2.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>(3.14)&lt;sup&gt;a&lt;/sup&gt; 3.75&lt;sup&gt;b&lt;/sup&gt; 4.38&lt;sup&gt;b&lt;/sup&gt; 4.85&lt;sup&gt;b&lt;/sup&gt; 3.32&lt;sup&gt;b&lt;/sup&gt; 5.27&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
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</tr>
<tr>
<td>Randombred</td>
<td>24</td>
<td>23.2±0.5&lt;sup&gt;c&lt;/sup&gt; 28.8±2.0&lt;sup&gt;c&lt;/sup&gt; 21.5±1.6&lt;sup&gt;c&lt;/sup&gt; 11.0±0.8&lt;sup&gt;c&lt;/sup&gt; 17.1±1.0&lt;sup&gt;c&lt;/sup&gt; 0.8±0.1&lt;sup&gt;c&lt;/sup&gt; 26.4±3.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>(3.1)&lt;sup&gt;b&lt;/sup&gt; 4.75&lt;sup&gt;c&lt;/sup&gt; 4.95&lt;sup&gt;c&lt;/sup&gt; 4.74&lt;sup&gt;c&lt;/sup&gt; 4.02&lt;sup&gt;c&lt;/sup&gt; 5.49&lt;sup&gt;c&lt;/sup&gt;</td>
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</table>

Mean±S.E.  
( ) : Mitotic index expressed as percentage of mitotic cells in total cell number in each tissue.  
Values in the same column with different superscripts are significantly different (p<0.05).

such as forebrain, hindbrain, neural tube, somite, notochord and blood corpuscles - blood islands. The sections from the cephalic and central axis regions of embryos were taken for counts. Mitotic index was calculated as the percentage of mitotic cell counts to total cell counts.

Data were analyzed with analysis of variance<sup>9</sup> to examine the differences among groups.

Results and Discussion

Data for somite number, the number of mitotic cells and mitotic index were presented in Table I. The decrease in somite number was more pronounced in the inbred lines in comparison with the crossbred and randombred populations, showing a marked retardation in the early embryonic development in inbred lines, while crossing of inbred lines had an effect of improving or restoring the embryonic development. These findings confirm the previous studies<sup>5,7</sup>.

The lowest number of mitotic cells were found in inbred lines. There were significant differences between inbred lines and randombred population in all tissues studied, and also between the inbred lines and the crossbreds except in notochords.

The mitotic indexes were also lower in the inbred lines than in the crossbred and randombred populations. Especially, there were significant differences between inbred lines and randombred population in all tissues except for neural tube and notochord. These results indicate that there has been a decline in the rate of cell division and proliferation in the inbred embryos. BERNIER et al.<sup>1</sup> also reported that inbreeding might result in a delay in the initiation of cell proliferation and/or a lower rate of cell proliferation in embryos. From these results, it is considered that a decrease in mitotic activity with inbreeding leads to a delayed and abnormal embryogenesis. While, number of mitotic cell and mitotic indexes were tended to be lower in crossbreds than in randombred population. This may be due to the effect of inbred female parent used by crossing. KRZANOWSKA<sup>6</sup> demonstrated that number of nuclei in crossbred embryos was similar to the maternal lines, suggesting that maternal effects were operating on the rate of cell division and proliferation during early stages. Further study will be necessary for this matter.

References

1) BERNIER, P.E., L.W. TAYLOR and C.A. GUNNS. The relative effects of inbreeding


