Comparison of Susceptibility to the T Strain of Reticuloendotheliosis Virus among Families of Japanese Quail

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It has been known that the hereditary factors of a host take part in the reaction of the host to various infectious diseases of domestic animals and fowls1. It has also been reported that participation of these factors is observed in the occurrence of the avian leukemia complex, lymphoid leukosis and Marek’s disease2,3,4,5).

Attention has been paid to reticuloendotheliosis virus (REV), as well as to the viruses of lymphoid leukosis and Marek’s disease, since all the three are tumorigenic viruses of chickens. Nevertheless, only a few papers on genetic control of susceptibility to REV have been published. In them, it was only reported that the susceptibility of the chicken to REV varied from one breed to another and was different from that to Marek’s disease6,7,8).

Japanese quail resembles chickens anatomically and physiologically and is susceptible to various infectious diseases of chickens. Although it is small in body size, it is robust and fecund. It can be reared and fed less expensively. Therefore, it has been noticed that it is available as model fowls of chickens9,10,11).

The authors have already reported the pathogenicity of the T strain of reticuloendotheliosis virus (REV-T) to Japanese quail. Since this strain was pathogenic to Japanese quail to essentially the same degree as for young chicks, the authors pointed out that Japanese quail might be used as models of chickens in the experimental infection of the REV-T12).

The present investigation was carried out to determine whether Japanese quail had any hereditary factor to participate in their susceptibility to REV-T. The susceptibility to this strain was compared among families of Japanese quail.

Materials and Methods

Experimental animals: The Japanese quail used was obtained from the flock maintained by random mating at the authors’ laboratory. Twenty families of a pair of male and female each were used for the experiment. They were allowed to have a formula feed for quail and drinking water ad libitum.

Origin of virus: The virus was obtained from Dr. Noboru Yuasa (Poultry Disease Laboratory, National Institute of Animal Health, Gifu). The source of inocula for these studies was liver obtained aseptically from previous passages and stored at -70°C. The liver was homogenized and suspended in Eagle medium. The final

Received December 27, 1976
concentration was 25 g of liver per 100 ml of buffer (10^6). For use, the emulsion was thawed rapidly at 37°C. The concentration of REV-T inoculated was 10^-2 which correspond to the LD 50 of this strain.

Infection experiment: Day-old quail were inoculated intraperitoneally with 0.1 ml of REV-T, raised in brooders of the quail house (at 35±2°C), and held under observation up to 21 days post inoculation. Observations were made on the interval of time between inoculation and death of quail, the number of dead quail and the mortality to 21 days post inoculation. The results of observation were compared among the families.

There was no sex difference in the susceptibility of quail to REV-T<sup>15</sup>. Therefore, in the present experiment, both males and females were used together, and the results obtained were subjected to statistical treatment.

Results

Table 1 shows the total number of Japanese quail inoculated with REV-T, the number of birds which died with the lapse of time post inoculation, the ratio of the total number of deaths to the total number of birds inoculated, mortality and the average number of days of survival. The first case of death from inoculation with REV-T occurred 5 days post inoculation. The highest frequency of death was observed 9-12 days post inoculation. Of the 275 birds, 170 died by 21 days post inoculation, showing a mortality of 61.8 per cent. The average number of days of survival was 15.1 days.

Table 2 indicates the total number of Japanese quail of each family inoculated with REV-T, the number of birds which died with the lapse of time post inoculation, the ratio of the total number of death to the total number of birds inoculated, mortality and the average number of days of survival. The first case of death from inoculation in each family occurred scatteringly from 5 to 12 days post inoculation. In 16 families or 80 per cent of all the families, it concentrated from 7 to 9 days post inoculation.

The number of birds which died with the lapse of time post inoculation was exhibited in two patterns. In one pattern, it was concentrated at 7-12 days post inoculation, as indicated in twelve families, Nos. 1, 2, 5, 6, 7, 9, 13, 14, 15, 16, 17 and 19. In the other pattern, it was scattered over a wide range of 5 to 21 days post inoculation, as indicated in six families, Nos. 3, 8, 10, 11, 18 and 20. These results reveal that there are differences in the pattern of mortality due to infection with REV-T among the families of Japanese quail.

The mortality in each family up to 21 days post inoculation was scattered within a range from 20.0 to 90.9 per cent. It was low in three families, Nos. 4, 12 and 17, which corresponded to 15 per cent of all the families examined. It was moderate in

<table>
<thead>
<tr>
<th>No. of quail</th>
<th>Days postinoculation when death occurred</th>
<th>No. dead/total</th>
<th>Average time to death (days)</th>
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<tbody>
<tr>
<td>275</td>
<td>2 1 7 8 32 13 21 51 7 7 4 4 1 5 1 4 2 170/275</td>
<td>61.8</td>
<td>15.1</td>
</tr>
</tbody>
</table>
seven families, Nos. 2, 6, 10, 11, 15, 16 and 18, which corresponded to 35 per cent of all those examined. It was high in four families, Nos. 1, 3, 8 and 19, which corresponded to 20 per cent of all those examined. Moreover, the χ² test indicated that there were clearly significant differences in the mortality among the families.

The average number of days of survival in each family was dispersed within a range from 10.7 to 19.5 days. In about half number of the families it concentrated from 14 to 16 days. The F test revealed that there were significant family differences in the average number of days of survival, as well as the mortality. In addition, there was a high significant correlation between the mortality and the average number of days of survival in each family.

As mentioned above, there were differences among the families in the number of deaths from infection with REV-T with the lapse of time post inoculation, the mortality, and the average number of days of survival. These results suggest that some hereditary factors might have participated in susceptibility to REV-T.

Another analysis was carried out to clarify the difference in pattern of mortality due to infection with REV-T between a group of Japanese quail showing a low susceptibility to this virus (group L) and another group showing a high susceptibility (group H). Group L consisted of 41 birds belonging to families in which the mortality was less than 35 per cent. Group H was composed of 48 birds derived from families in which it was more than 80 per cent. The two groups were compared in respect to

<table>
<thead>
<tr>
<th>Family</th>
<th>No. of quail</th>
<th>Days postinoculation when death occurred</th>
<th>No. dead/total</th>
<th>% Average time to death</th>
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<tr>
<td>1</td>
<td>11</td>
<td>4 1 1 2 2</td>
<td>10/11 90.9</td>
<td>10.7</td>
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<tr>
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<td>16.4</td>
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<tr>
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<td>12</td>
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<td>11/12 91.7</td>
<td>13.5</td>
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<tr>
<td>4</td>
<td>11</td>
<td>1 1 1 1</td>
<td>3/11 27.3</td>
<td>19.5</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>2 1 3 1</td>
<td>7/9 77.8</td>
<td>13.7</td>
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<tr>
<td>6</td>
<td>15</td>
<td>1 3 1 1 2 1</td>
<td>9/15 60.0</td>
<td>14.7</td>
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<tr>
<td>7</td>
<td>12</td>
<td>2 2 1 2 1</td>
<td>8/12 66.7</td>
<td>13.7</td>
</tr>
<tr>
<td>8</td>
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<td>10/12 83.3</td>
<td>14.1</td>
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<tr>
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<tr>
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<td>23</td>
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<td>13/23 56.5</td>
<td>17.3</td>
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<td>13</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td>11/13 84.6</td>
<td>11.9</td>
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<tr>
<td>20</td>
<td>17</td>
<td>2 2 5 1 1</td>
<td>12/17 70.6</td>
<td>14.2</td>
</tr>
</tbody>
</table>

Table 2. Mortality pattern of Japanese quail of each family strain inoculated intraperitoneally with REV-T.
to the number of deaths with REV-T. Fig. 1 shows the mortality in both groups on each day post inoculation. The first case of death occurred on 7 and 6 days post inoculation in the group L and H, respectively. The mortality was high in the group L on 12 and 14 days post inoculation and in the group H on 9, 11 and 12 days. There was no difference in mortality on each day later than 15 days post inoculation between the two groups.

From what was mentioned above it was clarified that the differences in the mortality and average number of days of survival between groups L and H were derived from the differences in the number of deaths in the early stage of infection up to 14 days post inoculation and in the time of appearance of a peak of between the two groups.

**Discussion**

In the present investigation, the susceptibility of Japanese quail to REV-T was compared among families of these birds. As a result, it was found that there were significant family differences in the mortality and the average number of days of survival. Then it was presumed that some hereditary factors might have participated in susceptibility to REV-T.

**SEVOIAN et al.** carried out an experiment to compare the LD 50 of REV-T between chickens of the S line susceptible for Marek's disease and commercial WR chickens which were different from the S line in hereditary background. As a results, they reported that there was no difference in this doses between the two groups of chickens. Furthermore WITTER et al. performed an infection experiment with REV-C on chickens of line 6 and line 7 which were resistant and susceptible, respectively, to Marek's disease. They found no difference in susceptibility to REV between the two lines of chickens. On the other hand, THEILEN et al. carried out an infection experiment with
REV-T on chickens of WL-151, WR×WC, RIR and RIR×BR. They reported that all the chickens of WL-151 and WR×WC had died, but that all the chickens of RIR and RIR×BR had remained alive up to 21 days post inoculation.

Besides the infection experiment with REV, Collins et al.14) conducted an experiment to compare susceptibility to ulcerative enteritis between a strain of Japanese quail selected on the basis of body weight at 3 weeks of age and its control. They found out that the mortality was higher in the selected strain than in the control and that this difference was significant. From these results, they reported that some hereditary factors participated in susceptibility to ulcerative enteritis.

The results of the present investigation suggest that some hereditary factors may take part in susceptibility to REV-T. To clarify such hereditary factors, it seems necessary not only to compare the susceptibility among families but also to estimate heritability and determine whether there is a selection response or not.

Moreover, the present investigation was performed to compare mortality pattern between two family groups divided by susceptibility. As a result, it was elucidated that the difference in mortality between the two family groups was derived from the difference in the number of death occurring in the early stage of infection up to 14 days post inoculation, and in the time of appearance of peak of death between these families. This peak appeared 2-3 days later in the family group showing low susceptibility than in that showing high susceptibility. From these results, it is presumed that one of the most remarkable differences between the family group showing low susceptibility and that showing high susceptibility may consist in the difference of host response to REV-T in the early stage post inoculation. It seems necessary to study the mechanism of this different response further from a pathogenic point of view.

Summary

The present investigation was carried out to determine whether Japanese quail had any hereditary factor to participate in their susceptibility to REV-T. The susceptibility was compared among families of Japanese quail.

1. Of the 275 birds, 170 died by 21 days post inoculation, showing a mortality of 61.8 per cent. The average number of days of survival was 15.1 days.

2. The mortality in each family was scattered within a range from 20.0 to 90.9 per cent. The $Z^2$ test indicated that there were significant differences in the mortality among the families.

3. The average number of days of survival in each family was dispersed within a range from 10.7 to 19.5 days. The F test revealed that there were significant family differences in the average number of days of survival.

4. The difference in mortality between two groups (low and high susceptibility) derived from the difference in the number of death occurring in the early stage of infection up to 14 days post inoculation, and in the time of appearance of a peak of death between these families.

5. It was presumed that some hereditary factors might have participated in sus-
ceptibility to REV-T, and that one of the most remarkable differences between the family group showing low susceptibility and that showing high susceptibility may consist in the early stage post inoculation.

This work was supported by Grants-in-Aid (No. 012207, No. 111507) for Scientific Research from the Ministry of Education, Science and Culture of Japan.

**Literature**

細網内皮症ウイルス T 株に対するウズラ家系間の感受性の比較

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岡山大学農学部, 岡山市 700

Reticuloendotheliosis virus (REV) の T 株に対する
ウズラの感受性に関する遺伝的要因の有無を検討する
目的で、REV-T 株に対する感受性について、家系間で
比較を行った。

用いたウズラは、当教室で飼育されている無作為交雑
群に由来するもので、雌雄 1 対からなる 20 組の家系を
作り、各々の家系から計 275 羽の初生ビナを生産し、実
験に供した。

用いたウイルスは、農林省家畜衛生試験場鶏病室寄り
与された REV-T 株の 20% 肝乳剤である。本実験
用いたウイルスは、上記乳剤を SPF 白色レギュラの
初生ビナに 1 代飼育した 25% 肝乳剤（これを 10^6 とし
た）に調整したものである。接種濃度は、REV-T 株の
LD 50 値に相当する 10^2 を用いた。

感染実験は、初生ビナの腹部内に、REV-T 株を 0.1
ml 接種し、育雛器内で飼育し、接種後 21 日目まで観察
を行った。

観察項目は、REV-T 株接種後の各家系におけるビナ
の死亡するまでの日数、死亡数、接種後 21 日目までの死
亡率などであり、得られた結果については、統計的有意
差について検定を加え、家系間で比較を行なった。

なお、T 株に対するビナの感受性には、性差が認めら
れてなかったので、本実験では、雌雄を含めて実験に供
し、統計処理を行なった。

得られた結果は次のものである。

1. REV-T 株接種後におけるビナ全体の死亡経過に
ついてみると、最初の死亡例は、接種後 5 日目に出
現し、死亡頻度の最も高い日は、接種後 9-12 日目にみら
れた。接種後 21 日目までの死亡率は、61.8%，平均生
存日数は、15.1 日であった。

2. 家系間の死亡経過については、最初の死亡例のみ
られる日は、接種後 5-12 日目までであり、家系間でバ
ラつきがみられたが、接種後 7-9 日目に家系が最も
多かった。また、接種後日数の経過に伴う死亡率は、明
らかに家系間で差がみられ、REV-T 株接種後 7-12 日目
に死亡が集中する家系と、接種後 5-12 日日に死亡がバ
ラつく家系がみられた。

3. REV-T 株接種後 21 日目までの家系死亡率は、
20.0% から 90.9% の範囲にバラつき、x^2 検定の結果、
家系間で明らかな有意差のあることが示された。

4. 各家系の平均生存日数は、10.7 日から 19.5 日の
範囲にバラつき、F 検定の結果、家系間で有意差が得ら
れた。

5. 家系死亡率 35% 以下の家系（L 群）と、80% 以
上の家系（H 群）の死亡率について比較したところ、最
初の死亡例が出現する日は、L 群では、接種後 7 日目、
H 群では 6 日目にみられた。死亡ビーグのみられる日
は、L 群では、接種後 12, 14 日目、H 群では、9, 11、
12 日目にみられた。また、接種後 15 日目以降の死亡経
過には、L 群と H 群の違いはみられず、感受性の低い
個体と高い個体の最も大きな違いの 1 つは、接種後初期
の、REV-T 株に対する宿主の反応にあることが考えら
れた。

6. REV-T 株接種後 21 日目における家系間の死亡率、接種
後 21 日目における家系死亡率、家系平均生存日数など
に、明らかな差が認められたことから、ウズラの REV-T
株に対する感受性に、遺伝的要因の関与していることが
推定された。

（家禽会誌 14, 259-265, 1977）