DIFFERENCES IN GROWTH AND THYROID FUNCTION OF PEKIN AND MUSCOVY DUCKS EITHER UNTREATED OR TREATED WITH STILBOESTROL.

By Hans von Faber and Wolfgang Häussermann

ABSTRACT

Pekin ducks grow faster and show a faster and higher thyroidal $^{131}$I uptake than Muscovy ducks. Treatment with a total of 15 mg stilboestrol during the first 4 weeks had no effect on growth, thyroid weight or thyroidal $^{131}$I uptake in male or female Pekin ducklings. In male Muscovy ducklings the same treatment caused a marked inhibition of growth, a decrease in thyroid weight and a lowered thyroidal $^{131}$I uptake. Thyroxine, administered simultaneously in physiological doses, did not prevent inhibition of growth. It is therefore concluded that this inhibition is not due to the lowered thyroid function.

Doses of 15 to 30 mg stilboestrol, as usually administered to broilers for inducing heigher weight gain and improving carcass quality, cause a marked suppression of growth in Muscovy ducks, while Pekin ducks do not respond in a similar manner (Faber 1961). Stilboestrol showed a tendency to increase thyroid weight in Pekin ducks and to decrease this in Muscovy ducks. It was therefore assumed that the stilboestrol-induced inhibition of growth was caused, at least partially, by a diminished thyroid function. In this investigation this was studied with a larger number of ducks.

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Eighteen Pekin and 14 Muscovy ducklings of both sexes which were hatched on May 22nd 1963 were used for a preliminary study of thyroidal $^{131}$I uptake. At the age of 4½ weeks, the animals were given an injection of 0.2 $\mu$C $^{131}$I as sodium iodide (carrier free) in 1 ml distilled water, into the lumen of the crop sac. At each of the intervals, i.e. 4 h, 8 h, 12 h, 16 h, 24 h, 48 h, and 72 h after the injection two birds, one of each sex, were killed. The thyroids were dissected out and weighed. Their radioactivity was measured with a well-type scintillation counter.

A second group of 29 Pekin and 39 Muscovy ducklings hatched on June 15th 1963 was used for the main experiment. As in the first trial the birds were fed pellets containing about 2.5 $\mu$g iodine per g. Eight male and 7 female Pekin ducklings and 12 male Muscovy ducklings were given intramuscular injections of 5 mg stilboestrol at the age of 7, 14, and 21 days. In addition, 11 Muscovy males with the same stilboestrol treatment were injected daily with thyroxine (8 $\mu$g, d,l-thyroxine from 7–13th day, 16 $\mu$g from 14–20th day and 24 $\mu$g from 21–27th day). Seven Pekin and 8 Muscovy ducklings of each sex remained untreated. At the age of 27 days all the birds were given an injection of 0.023 $\mu$C $^{131}$I in 1 ml of distilled water, into the crop sac. The animals were killed 24 hours after the injection. Both thyroids were weighed and then measured for their $^{131}$I uptake in a well-type scintillation counter.

In the preliminary experiment each point of the thyroidal $^{131}$I uptake curve was only based on the data of 2 birds. Since the natural variation proved to be high we performed a third trial in July 1964 with a total of 20 animals, 5 males and 5 females of each species. All birds were reared as described above and received at the age of 25 days an intramuscular injection of 5 $\mu$C $^{131}$I as sodium iodide (carrier free) in 0.1 ml distilled water. In this trial the radioactivity of the thyroid was measured directly in the living animals by a scintillation counter. A lead shielding collimator bridge, which was 140 mm long, 42 mm wide and had a wall thickness of 11 mm, was attached to the crystal. The animals were put on their back, the thyroid region being placed beyond the collimator. The measuring time was 2 minutes; a total count of 10 000 to 20 000 cpm was registered at each measurement. Counts were made at 1, 3, 5, 7, 24 and 72 hours after the injection. Immediately after the last measurement, the birds were killed and the thyroids dissected out. The radioactivity of the isolated glands was then measured in a well type scintillation counter and compared with a calibration standard. Thus the thyroidal $^{131}$I uptake expressed as a percentage could be determined.

RESULTS

Body weight: There was no sex difference in the body weight of male and female Pekin ducklings. In the case of the Muscovy ducks the males were much heavier than the females, the latter reaching only 80 per cent of the male weight ($P = 0.001$). Male and especially female Muscovy ducklings grew more slowly than Pekin ducklings (Table 1).

The stilboestrol treatment caused no significant suppression of growth in Pekin males and only a slight suppression in the females. The treated Muscovy males, however, showed a marked inhibition of growth, reaching only 65 per
Table 1.
Body weight, thyroid weight, and thyroidal $^{131}$I uptake.

<table>
<thead>
<tr>
<th>Species and treatment</th>
<th>n</th>
<th>Body weight g</th>
<th>Weight of the two thyroids mg</th>
<th>Relative thyroid weight mg/100 g</th>
<th>Thyroidal $^{131}$I uptake in °/o</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pekin, untreated, ♂ ♂</td>
<td>7</td>
<td>1162 ± 27</td>
<td>105 ± 8.2</td>
<td>9.0 ± 0.76</td>
<td>45.4 ± 2.50</td>
</tr>
<tr>
<td>Pekin, untreated, ♀ ♀</td>
<td>7</td>
<td>1159 ± 26</td>
<td>114 ± 17.4</td>
<td>9.8 ± 1.41</td>
<td>47.0 ± 2.76</td>
</tr>
<tr>
<td>Pekin, stilboestrol, ♂ ♂</td>
<td>8</td>
<td>1099 ± 40</td>
<td>88 ± 5.5</td>
<td>8.1 ± 0.57</td>
<td>43.0 ± 1.71</td>
</tr>
<tr>
<td>Pekin, stilboestrol, ♀ ♀</td>
<td>7</td>
<td>1021 ± 34</td>
<td>105 ± 6.9</td>
<td>10.3 ± 0.66</td>
<td>48.0 ± 2.02</td>
</tr>
<tr>
<td>Muscovy, untreated, ♂ ♂</td>
<td>8</td>
<td>847 ± 21</td>
<td>54 ± 1.9</td>
<td>6.3 ± 0.13</td>
<td>36.6 ± 1.17</td>
</tr>
<tr>
<td>Muscovy, untreated, ♀ ♀</td>
<td>8</td>
<td>669 ± 19</td>
<td>34 ± 1.7</td>
<td>5.2 ± 0.18</td>
<td>33.2 ± 2.10</td>
</tr>
<tr>
<td>Muscovy, stilboestrol, ♂ ♂</td>
<td>12</td>
<td>551 ± 29</td>
<td>35 ± 1.6</td>
<td>6.4 ± 0.20</td>
<td>30.3 ± 1.35</td>
</tr>
<tr>
<td>Muscovy, stilboestrol + T₄, ♂ ♂</td>
<td>11</td>
<td>535 ± 19</td>
<td>14 ± 0.8</td>
<td>2.6 ± 0.10</td>
<td>1.4 ± 0.07</td>
</tr>
</tbody>
</table>

cent of the normal weight ($P = 0.001$). This inhibition was not prevented by the simultaneous administration of thyroxine (Table 1).

Thyroid weight: The weight of the two thyroids was almost the same in both sexes of the Pekin ducks ($P > 0.05$). A distinct difference in the absolute as well as in the relative gland weight was observed in the two sexes of the Muscovy ducks ($P = 0.001$).

The weight of the thyroids of the Muscovy ducks was much lower than that of the Pekin ducks, being only 50 per cent in the males and 30 per cent in the females.

Stilboestrol had no significant influence on the thyroid weight in either sex of the Pekin ducks. However, in the male Muscovy, stilboestrol decreased the thyroid weight from 54 to 35 mg ($P = 0.001$). The administration of thyroxine caused a further decrease to 14 mg.

Thyroidal $^{131}$I uptake: The preliminary experiment with untreated birds showed that an uptake of about 40 per cent of the given dose was already found within 4 hours after the injection of the Pekin ducks. A further slight increase was observed up to 8 hours followed by a relatively slow decrease (Fig. 1). Four hours after the injection, the Muscovy ducks had accumulated
only 30 per cent of the administered $^{131}$I. A maximum of approximately 35 per cent was reached after 24 hours, followed by a slow decrease (Fig. 1).

The second trial with untreated birds gave similar, but somewhat clearer results. From Fig. 2 it is now obvious that there are significant differences between the two species in the first phase of thyroidal $^{131}$I uptake. The uptake occurs faster and reaches higher values in the Pekin than in the Muscovy ducks. An analysis of the curves shows that the rate of thyroidal $^{131}$I uptake is almost 3 times higher in the Pekin than in the Muscovy ducks. The maximum uptake was reached in the Pekin ducks 10 hours and in the Muscovy ducks 20 hours after the injection. However, the $^{131}$I releasing rate of the thyroid is almost the same in both species, the half life being about 90 hours. The thyroidal iodine uptake in female birds was a little higher than in male birds. The 24 hour values were 53.8 ± 4.7 % for male and 58.6 ± 5.6 % for female Pekin ducks, and 43.7 ± 2.0 % for male and 46.6 ± 2.5 % for female Muscovy ducks. Since the differences were not significant we have taken the values of both sexes together for the iodine uptake curve. The differences in the maximum uptake of the two experiments are explained in the different administration of the iodine. Both experiments, however, have shown that the thyroidal $^{131}$I uptake is complete at least 24 hours after the administration of iodine. The 24 hour values can thus be used for purposes of comparison.

In the main experiment only the uptake after 24 hours was measured. This uptake, which was about 45 per cent, was nearly the same in both sexes of the Pekin ducks. The Muscovy males showed an uptake of about 37 per cent, the females of about 33 per cent. However, this difference was not significant.

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**Fig. 1.**

Thyroidal $^{131}$I uptake of Pekin and Muscovy ducks after oral administration of $^{131}$I. Values with standard deviations.
The stilboestrol treatment had no effect on the $^{131}$I uptake in either sex of the Pekin ducks. In Muscovy males, however, it caused a significant decrease to 30 per cent ($P = 0.005$). Thyroxine almost completely blocked the selective uptake of $^{131}$I by the thyroids, even though the doses administered were small. Only 1.4 per cent of the injected iodine was found in the two glands.

**DISCUSSION**

Growth: Little is known about the influence of oestrogens on the body weight of ducks. Only Wang (1958) describes a growth-promoting effect of
stilboestrol in young (Pekin?) ducks. In this and in previous investigations we have observed almost no effect of stilboestrol on the growth of Pekin ducks (Faber 1961, 1964). The Muscovy duck is much more sensitive to oestrogens. A total of 15 mg stilboestrol, administered during the first 10 weeks, is sufficient to decrease the growth rate of males to that of the females (Faber 1961). In the Muscovy, but not in the Pekin duck, the growth of all long bones is also reduced by stilboestrol (Faber 1964). Once again this experiment demonstrates the sensitivity of the Muscovy duck to stilboestrol. This probably explains the very marked sex difference in growth of this species. At two weeks, the male Muscovy ducklings are already significantly heavier than the females and at 18 weeks they reach a weight of approximately 4100 g, i.e. twice as much as that of the females, which weighed 2000 g (Snyder 1962; Faber 1964). The endogenous oestrogens which originate in birds at a very early stage (Wolff 1959) may thus be the cause of the poorer growth of female Muscovy ducks.

Thyroid function: Tixier-Vidal & Assenmacher (1958, 1962) and Assenmacher & Tixier-Vidal (1963) reported a very low thyroidal uptake of $^{131}$I in Pekin ducks. Twenty-four hours after the intramuscular injections they found only 5 per cent of the administered iodine in 5 month-old males, and 14 per cent in 1 year old males. However, in a later experiment, they obtained much higher values (about 27 per cent) in 14–16 month-old Pekin males (Assenmacher & Tixier-Vidal 1963). But even these values range far below our own results (about 55 per cent). The age difference between their and our own ducks may be one of the reasons for the different uptakes. Growing birds generally show a higher iodine uptake than adult birds. For example, young cockerels have a greater uptake than adult fowls and their peak uptake is reached much earlier (Vlijm 1958; Himeno et al. 1961; Spronk 1961; Rosenberg et al. 1963). The thyroxine secretion rate in 6 week-old cockerels is about 3 times as high as in 12 month-old hens (Tanabe & Komiyama 1961).

Considering the small absolute and relative thyroid weight and the slower and lower thyroidal iodine uptake, the Muscovy ducks probably have a lower thyroid function than the faster growing Pekins.

No data have been found in the literature concerning the influence of oestrogens on the thyroid function in ducks. As our investigation showed, stilboestrol had no effect on the thyroid weight or the thyroidal $^{131}$I uptake in the Pekin ducks, but caused a decrease of both, in the Muscovy ducks. The lowered thyroid function was apparently not the cause of the growth suppression by stilboestrol, for a simultaneous administration of thyroxine could not prevent this inhibition of growth. Thyroxine was given in doses which corresponded to the normal thyroxine secretion rate in ducklings, i.e. 1.4–1.9 µg l-thyroxine per 100 g body weight per day (Billier & Turner 1950; Hoffmann 1950). It is therefore concluded that the oestrogen-induced inhibition
of growth is not due to the diminished thyroid function but rather to a lower release of growth hormone or prolactin.

REFERENCES

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