STEROIDOGENIC POTENTIAL OF THE TESTIS OF COLUMBA LIVIA DURING THE PREINCUBATION, INCUBATION AND SQUAB FEEDING PERIODS OF THE REPRODUCTIVE CYCLE

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ABSTRACT

Δ³-3 β-hydroxysteroid dehydrogenase (Δ³-3 β-HSDH), 17 β-hydroxysteroid dehydrogenase (17 β-HSDH), 11β-hydroxysteroid dehydrogenase (11β-HSDH), glucose-6-phosphate dehydrogenase (G-6-PDH) and NADH-diaphorase activity was observed in the Leydig cells and the seminiferous epithelium including Sertoli cells in the testis of the pigeon, Columba livia during the preincubation period. During the incubation and squab feeding periods Δ³-3 β-HSDH, G-6-PDH and NADH-diaphorase activity was observed and there was no activity of 17 β-HSDH and 11 β-HSDH in these cells. These results suggest that the testis of the pigeon during preincubation period actively synthesizes sex steroids while during incubation and squab feeding periods the testis might be relatively inactive in the synthesis of sex steroids as indicated by the absence of 17 β-HSDH and 11 β-HSDH enzyme activity.

INTRODUCTION

In birds, as in a majority of seasonal breeding vertebrates, the interstitial cells undergo well-defined secretory cycle which involves a rhythmic accumulation and depletion of cholesterol-positive lipoidal material14-15. The presence of Δ³-3β-hydroxysteroid dehydrogenase (Δ³-3 β-HSDH) and 17β-hydroxysteroid dehydrogenase (17 β-HSDH) in the Leydig cells and the seminiferous epithelium including the Sertoli cells in the testis of fowl, crow- pheasant, pigeon and hawk has been reported 4-11. The domestic pigeon, Columba livia is known to breed throughout the year12. The present work was designed to study whether there were any changes in the intensity of hydroxysteroid dehydrogenase activity during periods of preincubation, incubation and squab feeding to understand the steroidogenic potentiality of the testis of pigeon during the reproductive cycle by histochemical demonstration of Δ³-3β-HSDH, 17 β-HSDH, 11β-HSDH, G-6-PDH and NADH-diaphorase activity.

MATERIALS AND METHODS

The pigeons were obtained from the pigeon colony maintained in this University. The testes of the adult pigeon during preincubation, incubation and squab feeding were used for this study. The histochemical procedures followed were as described earlier13.

RESULTS AND DISCUSSION

The Leydig cells and the seminiferous epithelium including the Sertoli cells showed Δ³-3 β-HSDH (Figure 1), G-6-PDH and NADH-diaphorase activity throughout the reproductive cycle. However, the intensity of enzyme activity was reduced to certain extent during incubation (Figure 2) and squab feeding period (table 1). Further, 17β-HSDH and 11β-HSDH activity was observed in the Leydig cells and seminiferous epithelium including the Sertoli cells during preincubation period only (Figure 3; table 1).

The presence of Δ³-3 β-HSDH enzyme activity in the Leydig cells and the seminiferous epithelium including Sertoli cells suggests that the testis of C. livia is capable of converting Δ³-3β-HSDH hydroxysteroids to Δ³-3 ketosteroids. The enhanced Δ³-3 β-HSDH activity during the preincubation period suggests that the testis is very active in steroidogenesis during this period.

It is well known that the testis of birds synthesizes sex steroids 14-20. The synthesis of sex steroids involves another enzyme, 17 β-HSDH. This enzyme has been histochemically demonstrated in the testis of fowl13, crow-pheasant13 and hawk11. The presence of 17 β-HSDH in the Leydig cells and seminiferous epithelium including the Sertoli cells of the testis of pigeon during preincubation period provides an additional evidence for the synthesis of sex steroids. Chan and Pots13 have reported maximum testosterone
production by the testis of *Anas creca* during the breeding season. The incubation and squab feeding periods are supposed to be sexually inactive periods when the birds are engaged in bringing up of young fledglings. The absence of 17β-HSDH enzyme activity in the testis during the incubation and squab feeding periods might therefore suggest a low production of steroids.

Histochemical demonstration of 11β-HSDH in the testis has been reported in only one avian species. The presence of 11β-HSDH in the Leydig cells and the seminiferous epithelium during the preincubation period suggests their ability to convert 11β-hydroxy- androgens to 11-ketoandrogens as 11β-HSDH enzyme catalyses the conversion of 11β-hydroxyandrostenedione and 11β-hydroxytestosterone to 11 keto-androstenedione and 11-keto-testosterone respectively.

In conclusion, it is suggested that the testis of pigeon during preincubation period contains the three hydroxyroid dehydrogenases namely, Δ⁴-3β-HSDH, 17 β-HSDH and 11β-HSDH which suggests an active synthesis of androgens by the testis. This observation is also supported by the maximum display of sexual activity during the preincubation period, which is an androgen dependant phenomenon.

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### TABLE 1

**Δ^2-3 β-HSDH, 17 β-HSDH, 11 β-HSDH, G-6-PDH and NADH-diaphorase activity* in the testis of Columba livia during the reproductive cycle.**

<table>
<thead>
<tr>
<th>Enzyme and substrates</th>
<th>Preincubation period</th>
<th>Incubation and squab feeding periods</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Leydig cells</td>
<td>Seminiferous epithelium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leydig cells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seminiferous epithelium</td>
</tr>
</tbody>
</table>

1. **Δ^2-3 β-HSDH**
   - a. DHA   +++   +  +++±  ±
   - b. Pregnenolone  +++  +  +  ±
   - c. 17α-OH-pregnenolone  ++  ±  +  ±
   - d. Etioccholanolone  ++++  ++  +++  ±

2. **17β-HSDH (NAD-dependent)**
   - a. 17 β-estradiol  ++  ±  -  -
   - b. Testosterone   ++  ±  -  -

3. **17 β-HSDH (NADP-dependent)**
   - a. 17 β-estradiol  -  -  -  -
   - b. Testosterone   -  -  -  -

4. **11 β-HSDH**
   - 11 β-OH-androstenedione  +++  ++  +++  +

5. **G-6-PDH**

6. **NADH-diaphorase**

*Intensity of reaction is graded from (-) to (++++) ; (-) denotes the absence of reaction and (++++) a maximal reaction.