Changes in Plasma Concentrations of Progesterone, Testosterone and Estradiol during Moult Period in the Gifujidori Hens, Native Japanese Chicken.

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Introduction

Mouling in birds, accompanied by rapid regressions of the ovary and oviduct, generally occurs following the cessation of egg laying[1,2]. Thyroidal and gonadal hormones are supposed to involve in the oncoming and continuance of moult since the injections of thyroxine and progesterone can induce moult[3-8] while successive injections of estrogen inhibit it[9]. However, endocrine mechanisms of moulting is still unclear due to lack of detailed information on circulating hormone levels in moulting birds. The present study was conducted to determine the concentrations of sex steroid hormones during natural autumnal moult in the Gifujidori hen (gallus domesticus), a native Japanese chicken.

Materials and Methods

Six laying Gifujidori hens were housed in individual cages under natural photoperiods and supplied with food and water ad libitum from August to November, 1983. The moulted feathers of each hen were collected daily and weighed after desiccation. Eggs were removed daily and the hens were weighed every other day. Blood samples (1.5 ml) were collected between 12:00 and 13:00h, quickly centrifuged after the collection and separated plasma samples were stored at -20°C until used for assay. Plasma progesterone, testosterone and estradiol were measured by radioimmunoassay. A plasma sample (100 μl) was extracted with ethyl ether twice, and applied to Sephadex LH-20 microcolumn chromatography. Rabbit antiprogesterone 3-oxime-BSA serum, antitestosterone 11β-SUCC-BSA serum and antiestradiol 6-CMO-BSA serum were obtained from Teikoku Pharmaceutical Company, Tokyo.

Results

Moult: The moult occurred between September and November in all of the hens. Total weight of the moulted feathers amounted to 22.3-67.0g/hen during the mouling period for 16-31 days. The hens lost 10-20% of their body weight during the mouling period. Egg laying ceased 2 to 6 days before the onset of moult except for one hen that continued egg laying until day 2 of moult when she lost 3.2g of her feathers.

Sex steroid hormones (Table 1): The plasma concentration of sex steroid hormones in

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Table 1. Changes in plasma concentrations of progesterone, testosterone and estradiol during moulting period in Gifujidori hens.

<table>
<thead>
<tr>
<th>Periods</th>
<th>Progesterone (mean ±SEM, pg/ml)</th>
<th>Testosterone (mean ±SEM, pg/ml)</th>
<th>Estradiol (mean ±SEM, pg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-moulting</td>
<td>302 ± 24 (21) a</td>
<td>271 ± 16 (17) a</td>
<td>78 ± 8 (19) a</td>
</tr>
<tr>
<td>Mouling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>first period</td>
<td>128 ± 12 (18) b</td>
<td>201 ± 16 (17) b</td>
<td>42 ± 5* (16) bc</td>
</tr>
<tr>
<td>middle period</td>
<td>44 ± 4*(35) c</td>
<td>60 ± 6* (20) c</td>
<td>29 ± 3* (30) c</td>
</tr>
<tr>
<td>final period</td>
<td>112 ± 9 (17) b</td>
<td>156 ± 19 (12) d</td>
<td>48 ± 4* (18) b</td>
</tr>
<tr>
<td>mean</td>
<td>86 ± 5* (70) a</td>
<td>132 ± 12* (49) a</td>
<td>38 ± 3* (64)</td>
</tr>
<tr>
<td>Post-moulting</td>
<td>266 ± 33 (22) a</td>
<td>298 ± 24 (17) a</td>
<td>74 ± 4 (16) a</td>
</tr>
</tbody>
</table>

1) The onset of moult was decided as when the hen lost more than 0.2g of their feathers. Pre-moulting and post-moulting periods were a week before and after the onset or end of moult. The period of moult was divided into three periods: the first period as the first week of moult, the final period as the final week of the moult and the middle period as the period between the first and final weeks.

2) The bracketed numbers following means indicate number of assay.

3) Means followed by different letters differ significantly (p<0.01) in within each hormone by DUNCAN's new multiple range test.

* The means include undetectable values calculated as 20pg/ml plasma.

the pre-moulting period (during a week before the onset of moult) was 302±24 pg/ml in progesterone, 271±16 pg/ml in testosterone and 78±8 pg/ml in estradiol. The steroid levels in plasma, especially progesterone, began to decrease following the cessation of egg laying. The decreases in the mean concentration of those hormones in the first period of moult were significant, 42% in progesterone, 74% in testosterone and 54% in estradiol vs the values of the pre-moulting periods. The sex steroid concentrations attained the lowest levels in the second period of moult, their decremental ratio compared to the pre-moulting period was 85% in progesterone, 78% in testosterone and less than 65% in estradiol vs the values of the pre-moulting periods. The ratio must be more large especially in estradiol, since the undetectable value was calculated as 20 pg/ml. During the final period of moult the sex steroid concentrations in plasma tended to restore to the pre-moulting levels.

Discussion

Significantly low levels of plasma progesterone were detected in the autumnal moulting Gifujidori hens of the present study, and this agreed with reports on the same breed of hens by Kono et al. and on turkey hens by Scanes et al. This is also supported by the findings that the egg laying ceased with rapid regression of ovary and oviduct in the moulting hens and progesterone is mainly synthesised by the larger yellow follicles. These findings refute that progesterone act as an inducing agent of natural moult although the injection of progesterone can induce moult. Testosterone and estradiol concentrations in the plasma also decreased significantly in the present study. Significantly low levels of testosterone in plasma during moulting period was also reported in male and female Gifujidori chickens, male mallard ducks and male Guinea fowls. Testosterone administration prevented
moult in canary\textsuperscript{15}). Recently, JALLAGEAS et al.\textsuperscript{16} reported that in ducks administration of testosterone completely prevented the induction of moult which was induced by the pituitary stalk section. Estradiol also seems to have the protective effects because successive injections of estradiol prevented moult\textsuperscript{46}). Therefore the significant decrease of testosterone and estradiol in plasma might be connected with natural autumnal moult in \textit{Gifujidori} hens. It is well known that thyroxine has intensive inducing effect on moult by stimulation of the feather growth\textsuperscript{7,13}). ASSENMACHER and JALLAGEAS\textsuperscript{47} demonstrated that plasma thyroxine concentration increased 2-3 fold in moulting male duck and teal. However, the thyroid function was not activated in moulting hens\textsuperscript{5,6}) and male ducks\textsuperscript{16}), and the plasma thyroxine concentration did not show a significant increase in moulting turkey hens\textsuperscript{10}). It is supposed that decreased concentrations of testosterone and estradiol in plasma might induce the onset and progress of moult in hens, perhaps without remarkable increase of the plasma thyroxine level.

**Summary**

The concentrations of progesterone, testosterone and estradiol in plasma were determined in \textit{Gifujidori} hens during natural autumnal moult. The moulting period lasted 16-31 days and the hens lost 22.3-67.0 g of their feathers. The plasma sex steroids decreased significantly and attained the lowest levels in the middle period of moult. The mean concentrations during moult were 86±5 pg/ml in progesterone, 132±12 pg/ml in testosterone and 38±3 pg/ml in estradiol.

**References**

14) ITOH, H., T. KONO and K. ICHINOE (1985) Annual variations in copulatory organ size, semen volume
KONO* et al.: Changes in plasma concentrations of sex steroids during moulting


Kojidai Gyoketsu in eru Yakuware no Kasei Progesterone,
Testosterone to Estrolju Adou no Kajitsu

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Kojidai Gyoketsu in eru Shiki no Jinkai Yakuware no Kasei
Kasei Hormon Kajitsu o Azumeteta. Koyosan no Yakuware
Jikan no 16 to 31 gazu byo Yakuware Housou wa 22.3 g to 67.0 g de
Aatta. Kasei Hormon no Kasei Hormon浓度 wa, Yakuware no Kajitsu
Houko byo Yakuware no Kajitsu ni Boku to
Kasei Hormon 44±4 pg/ml, Testosterone 60±6 pg/ml
Kasei Hormon 29±3 pg/ml de Aatta. Jinkai Yakuware
Kajitsu no 23, 104~107, 1986]