

# Changes in the Plasma Corticosterone Concentration under Restraint Stress in Gifujidori Roosters at Different Ages

By

Takehito KUWAYAMA\*

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**Summary** : Roosters at 10, 20, 30, 60 and 90 weeks of age were put under restraint on a board and the plasma concentrations of corticosterone at 5, 15, 30 and 60 minutes after the onset of the restraint were measured by radioimmunoassay. All birds showed an increase in the corticosterone concentration at all times. The amount of increase was greater in the younger birds, but the increase rate per minute was different between ages of birds, and between periods of restraint. The present results suggest that the younger birds are more responsive to the restraint than the old birds and the resistibility against the stimulus is different among various ages of birds.

**Key words** : corticosterone, stress, roosters, age difference

## Introduction

Gifujidori is a Japanese native breed of chicken and has been raised to supply delicious meat. In animals, including birds, any external or internal shock given to the living body causes various physiological changes called general adaptation syndromes<sup>1)</sup>. The physiological status manifesting the general adaptation syndromes is called stress<sup>1)</sup>. One of the changes is an increase in the secretion of glucocorticoid hormones from the adrenal gland, and therefore, the increase in the glucocorticoid hormone secretion has been widely used as an index of stress<sup>2-6)</sup>. Major glucocorticoid hormone in the chicken is corticosterone<sup>7)</sup>. The present study was performed to demonstrate whether the stress caused by restraint in Gifujidori roosters differs between the birds at different ages.

## Materials and Methods

Gifujidori roosters were raised in group-housing cages (88 cm in width, 66 cm in depth, 40 cm in height ; for 5 birds) up to 10 weeks of age, and thereafter in individual cages (20 cm W, 45 cm D, 40 cm H). They were fed with a commercial diet given *ad libitum* consumption. Water was available at all times. At 10, 20, 30, 60 and 90 weeks of age, 5 birds at each age were used

for experiments starting at around noon. The body weight of the birds was 0.6 kg (10 wks), 1.1 kg (20 wks), 1.3 kg (30 wks), 1.5 kg (60 wks) and 1.6 kg (90 wks) in average, respectively.

The birds were put under restraint, tied with an elastic belt on a board, and kept for 60 minutes. Blood (1 ml) was collected from the wing vein at the onset of restraint and at 5, 15, 30 and 60 minutes of restraint, and the plasma was obtained and kept in a freezer at  $-30^{\circ}\text{C}$ . Concentrations of corticosterone were measured by the use of a routine radioimmunoassay<sup>8)</sup>. The antibody used was A906/R1T (Biogenesis Ltd). The intra-assay coefficient of variation was 12.4%.

## Results

The concentration of corticosterone in the plasma of roosters of all ages increased under restraint. Table 1 shows the amount of increased concentration of corticosterone from the onset of the restraint up to 5, 15, 30 and 60 minutes after the restraint, which was calculated from the concentration measured on each sample at each time by subtracting the concentration at the onset of the restraint. The concentration at the onset of restraint was listed in the footnote of the table. In roosters at 10 weeks of age, the amount of increased concentration was greater than that of the birds of

\* Department of Animal Science, Faculty of Agriculture, Tokyo University of Agriculture

other ages at 5, 15, and 30 minutes of the restraint. At 60 minutes, the birds at 10 and 20 weeks of age showed a greater increase than the birds at 60 and 90 weeks of age.

Table 2 shows the increase in the corticosterone concentration per minute of restraint. The increase per minute during the first 5 minutes was greatest in the birds at 10 weeks of age. It decreased after 5 minutes in the birds at 10, 20, and 30 weeks of age and after 15 minutes in the birds at 60 and 90 weeks of age. During the last period of 30 minutes (30–60 min.), the increase per minute was much less in the birds at 10 and 90 weeks of age than in the birds at 20, 30, and 60 weeks of age.

### Discussion

An increase in the secretion of glucocorticoid hormone such as corticosterone, cortisol or cortisone is known to be a defensive response of animals under stress<sup>1)</sup>. The stress is caused by various alarming stimuli or stressors given to the living body, irrespective of the kind of stimuli<sup>1)</sup>. The glucocorticoid hormone is thought to be concerned in the defense mechanism against shock by recovering from various changes evoked in tissues and in blood. In the present study, restraint was adopted as a stressor, and the

corticosterone concentration in the plasma was examined in various week-old roosters of Gifujidori breed. The increase in the concentration during restraint was expressed as the concentration subtracting the concentration at the onset of restraint (Table 1). The expression may be plausible because the concentration at the onset of the restraint was different between the birds at different ages (see the foot-note of Table 1). The amount of the increase in the concentration of corticosterone was found to be greater in the younger birds than in the old birds during the whole period of restraint. This suggest that younger birds are more responsive to shock than older birds.

When the degree of the increase in the corticosterone concentration was compared as the increased amount per minute, difference in the aspect of the increase was apparent between the birds at the different ages (Table 2). The difference may be due to difference in the resistibility to shock given by the restraint, i.e in the recovering ability from adaptation syndromes, between the birds at younger and older ages.

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**Table 1** Increased concentration of corticosterone in plasma of Gifujidori roosters under restraint

Age in weeks	Increased corticosterone concentration <sup>1</sup> (ng/ml) at:											
	5min.			15min.			30min.			60min.		
10	4.12	±	0.96 * b **	5.52	±	0.90 * b **	6.82	±	1.15 * b **	9.18	±	1.76 * b **
20	1.68	±	0.58 a	2.46	±	0.72 a	4.39	±	1.07 a	9.89	±	1.27 b
30	0.88	±	0.15 a	1.66	±	0.16 a	3.44	±	0.47 a	8.12	±	1.39 ab
60	1.05	±	0.23 a	3.42	±	0.68 a	4.43	±	0.33 a	7.59	±	1.18 a
90	0.95	±	0.25 a	2.19	±	0.34 a	3.21	±	0.57 a	4.64	±	1.05 a

<sup>1</sup> Concentration at each time minus concentration at the onset of restraint

\* Mean of 5 birds ± SE

\*\* Different letter indicates significant difference (P<0.05) by Duncan's new multiple range test<sup>9)</sup>.

Concentration (ng/ml) at the onset of restraint was 2.20 ± 0.15(n=5) at 10weeks of age, 1.38 ± 0.06 (n=5) at 20 wks, 0.59 ± 0.09 (n=5) at 30 wks, 0.51 ± 0.11 (n=5) at 60 wks and 0.55 ± 0.09 (n=5) at 90 wks, respectively.

**Table 2** Increase in the corticosterone concentration per minute of restraint<sup>1</sup>

Age in Weeks	Increased Concentration (ng/ml) During the Period of:			
	0-5min.	5-15min.	15-30min.	30-60min.
10	0.824	0.140	0.087	0.079
20	0.336	0.078	0.127	0.183
30	0.176	0.078	0.052	0.153
60	0.210	0.237	0.067	0.115
90	0.181	0.124	0.068	0.048

<sup>1</sup> calculated from the data shown in Table1.

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# いろいろな週齢の岐阜地鶏雄鶏における緊縛 ストレス下の血漿コルチコステロン濃度の変化

桑山 岳人\*

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要約: 10, 20, 30, 60 および 90 週齢の岐阜地鶏雄鶏を緊縛し, 5, 15, 30 及び 60 分後における血漿コルチコステロン濃度をラジオイムノアッセイで測定した。血漿コルチコステロン濃度は全ての鶏で上昇し, 上昇程度は若齢の方が老齢の鶏よりも大であった。1 分当たりの上昇程度は鶏の週齢によって異なり, また緊縛開始後の時間によって異なっていた。本実験から, 若齢の鶏の方が緊縛ストレスに敏感であること, またそのストレスに対する抵抗性は週齢によって異なることが示唆された。

キーワード: コルチコステロン, ストレス, 雄鶏, 週齢差

\* 東京農業大学農学部畜産学科