

琉球大学学術リポジトリ

雄鶏の血中カルシウム濃度におよぼす去勢,
下垂体前葉除去および飢餓の影響について(畜産学科)

メタデータ	言語: 出版者: 琉球大学農学部 公開日: 2008-02-14 キーワード (Ja): キーワード (En): 作成者: 仲田, 正, 古賀, 脩 メールアドレス: 所属:
URL	http://hdl.handle.net/20.500.12000/4063

Non-effectiveness of Castration, Hypophysectomy and Starvation on Plasma Calcium Concentrations in Cocks[#]

Tadashi NAKADA* and Osamu KOGA**

I INTRODUCTION

It is well known that the concentration of blood calcium in the laying hen abruptly increases when she approaches sexual maturity⁶⁾. During laying period, the blood calcium concentration attains to levels that fluctuate daily between 20-30 mg%²⁾. However, when the hen ceased to lay at molting and broodiness, the blood calcium concentration decreases to about 10 mg%, i. e. to the level of nonlaying hens¹²⁾. The abrupt increase and the striking decrease of the blood calcium level in the laying hen are assumed to be related to the activity of the ovary. In male birds, on the other hand, the blood calcium concentration does not change with the sexual maturity⁹⁾, and is maintained at about 10 mg% throughout immature and mature periods. Estrogen administration to cocks or capons can raise blood calcium levels exceeding 100 mg%⁵⁾. Cocks have potentiality of increasing the blood calcium level more than the normal levels of 10 mg%. It is not known whether the gonad (testes) in the males has any influences on the maintenance of the blood calcium concentration. In the present experiments, castration and hypophysectomy were made in cocks to demonstrate the role of the function of the testis and the hypophysis for the blood calcium concentration. In addition, the effect of starvation was also examined.

II Materials and Methods

Birds

New Hampshire and White Leghorn cocks were used. The birds were kept in individual cages, fed *ad libitum* on a commercial breeder mash contain about 3% calcium and exposed 14 h of light (0500-1900) per day.

Surgical procedures and starvation

Castrations were performed in New Hampshire cockerels at 10 weeks of age. Hypophy-

* Department of Animal Science, College of Agriculture, University of the Ryukyus

** Faculty of Agriculture, Kyushu University, Fukuoka - shi 812

This paper was presented in part at the 29th annual meeting of the West Japanese Society of Zootechnical Science in Kagoshima on November 1978.

Sci. Bull. Coll. Agr. Univ. Ryukyus, 28 : 197 ~ 202 (1981)

sectomies were performed in White Leghorn cockerels at the same age, using the method of Tanaka and Nobukuni (1976)¹¹⁾ with a slight modification. In this operation, the birds were anesthetized and placed in a dorsal position on a streatoxic apparatus with the beak-holder in an over-extended position. The anterior pituitary was gently removed by mouth-sucking through a tapered glass tube (1.2mm in diameter) connected to a vinyl tube, after the base of the skull was drilled at the level of the sella turcica. The castrated and hypophysectomized cockerels were reared in individual cages at room temperature ranging from 23°C to 28°C. Only those birds that were verified a complete removal of the organs by autopsy were used in the data.

For starvation, White Leghorn cocks of 20 weeks of age were deprived of food for six days. Drinking water was allowed *ad libitum*.

Determination of plasma total calcium

Approximately 0.5ml. of blood was collected from the wing vein with a heparinized syringe, and the plasma was obtained by centrifugation (3,000 r.p.m. for 10 min.). Calcium concentration was determined, in 0.05 ml. aliquot of plasma, by using a calcium estimation kit (C-Test wako, Wako Pure Chemical Industries, LTD). Blood for plasma calcium estimation was taken just before and 10, 20 and 30 weeks after castration.

III RESULTS

Plasma calcium concentration after castration

Table 1. Changes in the plasma calcium concentration before and after castration

Treatment	No. of hens	Just before castration	Weeks after castration		
			10	20	30
Castration	10	9.79 ± 0.30 [#]	9.80 ± 0.12	9.76 ± 0.40	9.90 ± 0.64
Sham - op*	8	9.85 ± 0.45	9.90 ± 0.31	9.77 ± 0.25	10.05 ± 0.35
Intact	8	9.73 ± 0.25	9.76 ± 0.45	9.75 ± 0.54	9.76 ± 0.43

[#] Mean ± SD

* Sham - operation

As shown in Table 1, no significant difference in the mean calcium concentration was found among the plasma samples collected before and after castration, and between those of intact and sham operated cocks of the same age.

Plasma calcium concentration after hypophysectomy

The mean plasma calcium concentrations in hypophysectomized and sham-operated cocks were almost constant throughout the period from the preoperation to six days after post-operation (Table 2). There was no significant difference in the mean calcium concentration

Table 2. Changes in the plasma calcium concentration before and after hypophysectomy

Treatment	No. of hens	Just before hypophysectomy	Days after hypophysectomy					
			1	2	3	4	5	6
Hypox *	9	10.86 [#]	9.97	10.73	10.22	11.00	10.10	10.67
		±	±	±	±	±	±	±
		0.54	0.36	0.56	0.46	0.38	0.42	0.60
Sham-op **	6	10.82	10.01	10.20	10.30	10.23	10.40	10.30
		±	±	±	±	±	±	±
		0.60	0.40	0.32	0.54	0.20	0.45	0.35
Intact	5	10.50	10.95	10.43	10.70	10.20	11.15	10.65
		±	±	±	±	±	±	±
		0.40	0.23	0.45	0.50	0.15	0.75	0.56

* Hypophysectomy

** Sham operation

Mean ± SD

between the operated and the intact birds.

Plasma calcium concentration after starvation

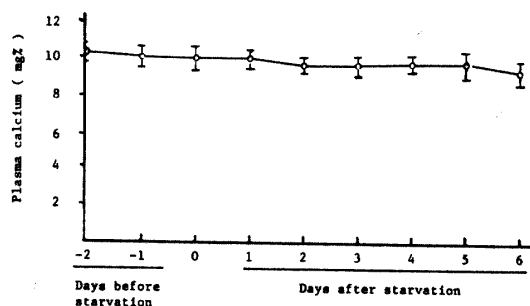


Fig. 1 Changes in the plasma calcium concentration before and after starvation

0: Just before starvation

Each point represents the average of data from ten cockerels

As shown in Fig. 1, the plasma calcium concentration was shown to be a uniform level throughout the period of pre- and post-starvation.

IV DISCUSSION

If the testis plays some role in maintaining the blood calcium concentration in normal cocks, the removal of the testis may bring about some changes in the blood calcium concentration. It was revealed that the concentration remained unchanged and showed a stableness throughout the periods before and after the castration (Table 1).

Androgen^{4), 8)} and progesterone^{3), 1)} but not estrogen were detected in the testis¹⁰⁾ and the blood of cocks¹⁰⁾. The blood calcium concentration of cocks having normally functioning

testes was found to be almost similar to that of cocks without testes as shown in Table 1. Riddle and Dotti (1936)⁷⁾ reported that testosterone, unlike estrogen, completely devoided of calcium-raising action in both female and male pigeons and rats. A similar phenomenon is observed if capons are injected with androgen¹⁰⁾. Progesterone has almost no effect to increase the concentration of calcium in the blood in these animals¹³⁾. From the results of Table 1 and these reports, it appears that the testis is not responsible for the maintenance of blood calcium concentration.

A normal functional pituitary gland is essential for initiating the development and maintenance of the testis in the cocks. Furthermore hypophysis has influences on the functions of not only gonads but also many other endocrine glands. The data in Table 2 showed that the blood calcium concentrations were almost unchanged before and after hypophysectomy. These results suggest that the pituitary gland does not participate in the control of the concentration of the blood calcium in cocks.

Adequate food is essential to maintain male in good reproductive condition¹³⁾. Starvation causes hypofunction of the hypophysis leading the regressive change of the testis¹³⁾. It is conceivable that starvation stops not only the supply of calcium from diet but also severely suppresses the secretion of hypophyseal hormones and testicular hormones. However, in such birds the blood calcium concentrations were maintained at a uniform level in pre and post-fasting period for six days (Fig. 1). In laying hen, on the other hand, starvation leads to a marked reduction of the concentration of the plasma calcium from the normal level of more than 20mg% to about 10mg% within four days and the plasma calcium remained at approximately this level for the duration of this experiment (Authors unpublished).

From the results in this experiment, it appeared that hypophysis and other endocrine glands under control of it, including the testis, do not affect the maintenance of the blood calcium concentration. It is suggested that the level of calcium concentration of blood which is sustained in the absence of these organs may be the basal level which is physiologically essential for the maintenance of normal body activity.

V Summary

The concentration of calcium in the blood plasma before and various times after castration, hypophysectomy and starvation was determined in cocks. The results obtained are as follows;

- 1) Removal of the testis and the anterior pituitary gland did not affect the calcium concentration of the blood plasma.
- 2) Starvation for six days unaffected the blood calcium concentration.

These results suggest that the calcium concentration which is stably maintained in cases of castration, hypophysectomy and starvation may be the basal level of calcium

concentration in cocks.

The authors thank Dr. Hisayoshi NISHIYAMA and Dr. Kousaku TANAKA, Faculty of Agriculture, Kyushu University, for their much helpful advice.

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雄鶏の血中カルシウム濃度におよぼす去勢，下垂体前葉除去および飢餓の影響について

仲田 正*・古賀 脩**

要 約

雄鶏に対する去勢，下垂体前葉除去および飢餓処理が血中カルシウム濃度の変動に如何なる影響をおよぼすかについて調べた。結果は次の通りである。

- 1) 去勢および下垂体前葉除去の前後における血中カルシウム濃度は殆んど同様であった。
- 2) 飢餓処理の前後における血中カルシウム濃度に有意差は認められなかった。飢餓処理期間中（6日間）においても顕著な変動を示さなかった。

以上の結果から，雄鶏において去勢，下垂体前葉除去および飢餓状態でも維持されている約10mg%大の血中カルシウム量は生体にとって基本的なカルシウムレベルであると思われる。

* 琉球大学農学部畜産学科

** 九州大学農学部畜産学科