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≪Research Note≫

Effects of Caponization on Growth Performance and Carcass Traits in Hinai-jidori Chicken

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Hinai-jidori is a popular brand chicken in Japan. Most Hinai-jidori chickens commercially available are females; in contrast, male chicks have been unused. To make unused male Hinai-jidori chicks more usable, an experiment was conducted to examine whether caponization influences growth performance and carcass traits in Hinai-jidori chicken. Hinai-jidori chicks were divided into female, capon, and male groups of 15 birds at 4 weeks of age. Male chicks in the capon group were caponized at 8 weeks of age. Five birds from each of the three groups were slaughtered at 22, 26 and 30 weeks of age, respectively. In the live body weight and daily weight gain, there was no significant difference between the capon and male groups from 18 to 26 weeks of age, while the female group showed the least live body weight and daily weight gain among the three groups throughout the experimental period. In the carcass traits, the capon group showed higher proportion of whole leg and total meat than the female group at 26 and 30 week of age. The capon group had heavier abdominal fat weight than the male group at 26 weeks of age. There was no significant difference in the proportion of abdominal fat between the two groups at all weeks of age. Since capons gain body weight equivalent to males until 26 weeks of age and gain abdominal fat comparable to females, caponization is useful to apply Hinai-jidori males to commercial use.

Key words: capon, caponization, carcass traits, growth performance, Hinai-jidori

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Introduction

Capons are male chickens whose testes are surgically removed. Because of the resultant deficiency of androgen, caponized cockerels lack the characteristic large comb and wattles associated with sexually mature roosters and become more docile and less active (Loyal, 1936). Energy that is normally expended in fighting, courting behavior, and territorial protection is greatly reduced, allowing more efficient conversion of feed into growth, fat deposition, and improved meat quality (Jacob and Mather, 2000). The principal objects of caponizing are to secure economical gains in meat yield, retain soft and palatable meat, and obtain a better market price. Capons have not been marketed in Japan.

Hinai-dori is a breed of chicken native to Akita Prefecture of Japan. A Hinai-jidori, a cross between the Hinai-dori and a Rhode Island Red breed has been commercialized as the Hinai-jidori chicken, one of the most popular brand of chicken in Japan. Hinai-jidori chickens are fed for approximately 24 weeks of age and the feeding period is much longer than broiler chickens. Almost 100% of Hinai-jidori chickens sold in the market are females; in contrast, male chicks are divided from females and sacrified immediately after hatching, because male meat is less fat and tougher than females. The exclusion of male chicks is one of the causes of high chick price and increases production costs. The feeding methods were examined with the aim of making Hinai-jidori males usable because males could not produce fatty meat as females (Sasaki *et al.,* 1999; Togashi *et al.,* 2000; Ishizuka and Yamamoto, 2001). It has been reported that caponization increased the live weight (Akter *et al.,* 1996; Chen *et al.,* 2000a; Mast *et al.,* 1981; Welter, 1976; Rahman *et al.,* 2004) and abdominal fat weight (Cason *et al.,* 1988; Chen *et al.,* 2000ab, 2005; Fennel and Scanes, 1992; Ono *et al.,* 1979) in capons as compared with males. If the effect of caponization is expressed in Hinai-jidori chickens fed for a long period, it would make male chickens more usable for the Hinai-jidori production. Hence, the aim of this study was to investigate the effects of caponization on growth performance and carcass traits in Hinai-jidori chicken.

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Materials and Methods

Bird and Bird Management

The chicks of Hinai-jidori were raised to 4 weeks of age

in temperature-controlled wire-floored and four-tier batteries. They were divided into female, capon, and male groups of 15 birds at 4 weeks of age, and thereafter were raised in an open-sided poultry shed with access to a grass paddock. This experiment was conducted from April 4 to October 3 in 2007. The following commercial diets were used: 1) chick starter (CP 21% ME 2,900 kcal/kg) for chicks 1–4 weeks of age; 2) first grower (CP 18% ME2, 850 kcal/kg) 4–10 weeks of age; 3) second grower (CP 15% ME 2,800 kcal/kg) 10–14 weeks of age; and 4) finisher (CP 15% ME 2,900 kcal/kg) 14–30 weeks of age. Feed and water were provided *ad libitum*.

Caponization

The caponization procedure was performed at 8 week of age according to Okuyama (1953). The capon group was deprived of feed for 12 h before caponization to avoid excessive bleeding during surgery and to make the testicles visible and easier to remove. The bird was fastened to a clean wooden work surface. The wings and legs were fastened and the bird was stretched out to its full length in order to expose the rib cage area. The skin was disinfected with 70% ethanol. The testes were removed through the last two ribs using caponizing forceps. The air accumulated under skin was released by carefully puncturing the skin with a sharp instrument after about one week.

Measurements

Growth Performance

The live body weight was measured at 4, 10, 14, 18, 22, 26 and 30 weeks of age. The daily gain weight was calculated from the live body weight.

Teststerone Concentration

Blood samples from five birds each of capons, females and males were taken from the brachial vein. Blood testosterone concentration was measured at 10, 14, 18, 22, 26 and 30 weeks of age using a testosterone EIA kit (Cayman Chemical Company., USA).

Carcass Traits

At 22, 26 and 30 weeks of age, five birds from each group were chosen at random. They were slaughtered after fasting for 18 hours and weights were obtained just prior to slaughter. After they were bled and plucked, the carcasses were cooled in ice-cold water until the temperature dropped to 8℃, and then hung for 30 minutes. The carcasses were dissected and separated into portions of leg, breast, tender, wing, heart, liver, gizzard, and abdominal fat. The legs and breasts were deboned and each of portions was weighed. The proportions of carcass were calculated from the weight of each portion to the live body weight.

Statistical Analysis

Data were analyzed using Statview program (SAS Institute Inc., USA) and are shown as average±standard error. When significant differences were detected, means were separated using ANOVA and Fisher's PLSD.

Results

Testosterone

The course of blood testosterone concentration of females, capons, and males was compared (Fig. 1). The blood testosterone concentration of males was significantly higher than that of capons and females after 14 weeks of age ($P<0.01$). There was no significant difference between capons and females at all weeks of age.

Growth Performance

The course of the live body weight of females, capons, and males was shown (Table 1). Capons and males were significantly heavier than females at all weeks of age ($P<0.05$). There was no significant difference in the live weight between capons and males after 18 weeks of age, although the live weight of capons was significantly poorer than that of males at 10 and 14 weeks of age ($P<0.05$).

The course of the daily weight gain of females, capons, and males was shown (Table 2). Capons and males gained significantly more weight than females at all weeks of age ($P<0.05$) as well as the body weight. Capons gained significantly more weight than males from 10 to 18 weeks of age ($P<0.05$), although the daily weight gain of capons was significantly poorer than males at 4–10 weeks of age ($P<0.05$). There was no significant difference in the daily weight gain from 18 to 26 weeks of age between the two groups. However, the daily weight gain of capons was significantly poorer than that of males at 26–30 weeks of age ($P<0.05$).

Carcass Traits

The carcass traits of females, capons, and males at 22, 26 and 30 weeks of age were shown (Table 3). Males had the highest proportion of whole leg meat at all weeks of age among the three groups ($P<0.05$). Capons had a significantly higher proportion of whole leg meat than females at 26 and 30 weeks of age ($P<0.05$). There was no significant difference among the three groups at 30

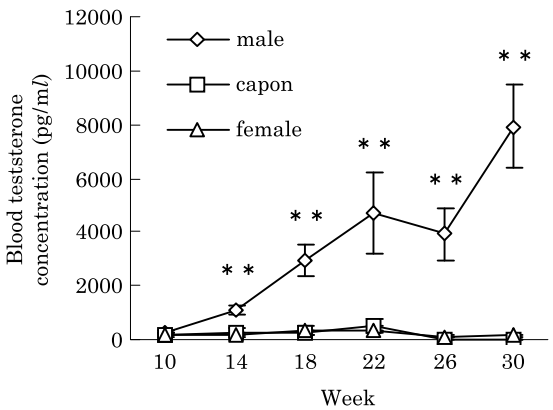

Fig. 1. **The course of blood teststerone concentration in females, capons and males of Hinai-jidori chicken.**
Mean±S.E. ($n=5$).
**, Significant difference between females, capons and males; **, $P<0.01$.

Table 1. **Comparisons of females, capons and males on live body weight of Hinai-jidori chicken**

	Female	Capon	Male
4 weeks of age	369± 5[b]	417± 8[a]	417± 8[a]
10 weeks of age	1253±23[c]	1357±36[b]	1634±40[a]
14 weeks of age	1709±32[c]	2121±56[b]	2324±50[a]
18 weeks of age	1719±44[b]	2907±66[a]	3035±41[a]
22 weeks of age	2542±61[b]	3492±80[a]	3538±51[a]
26 weeks of age	2719±102[b]	3925±98[a]	4031±62[a]
30 weeks of age	2895±139[b]	4169±98[a]	4384±69[a]

Mean±S.E. ($n=15$).
[a, b, c] Means within the same row with different superscripts are significantly different ($P<0.05$).

Table 2. **Comparisons of females, capons and males on daily weight gain of Hinai-jidori chicken**

	Female	Capon	Male
4–10 weeks of age	21.0±0.5[b]	22.4±0.7[b]	29.0±0.8[a]
10–14 weeks of age	16.3±0.5[c]	27.3±1.3[a]	24.6±0.5[b]
14–18 weeks of age	15.8±0.7[c]	28.1±0.8[a]	25.4±0.7[b]
18–22 weeks of age	14.0±0.9[b]	20.9±1.2[a]	17.9±1.1[a]
22–26 weeks of age	6.2±2.6[b]	15.5±1.0[a]	17.6±0.7[a]
26–30 weeks of age	3.6±2.8[c]	8.7±1.0[b]	12.6±0.9[a]

Mean±S.E. ($n=15$).
[a, b, c] Means within the same row with different superscripts are significantly different ($P<0.05$).

weeks of age in the proportion of breast meat, although females had a significantly higher proportion of breast meat than capons and males at 22 weeks of age ($P<0.05$) and capons and females had a significantly higher proportion of breast meat than males at 26 weeks of age ($P<0.05$). There was no significant difference in the proportion of tender meat among the three groups at all weeks of age. Males had the highest proportion of total meat among the three groups at all weeks of age. Capons had a significantly higher proportion of total meat than females at 26 and 30 weeks of age ($P<0.05$), although capons had a significantly lower proportion of total meat than females at 22 weeks of age ($P<0.05$). For the internal organs, females had a significantly higher proportion of liver than capons and males at 30 weeks of age ($P<0.05$). Females also had a higher proportion of gizzard than males at 22 and 26 weeks of age. Capons had a significantly higher proportion of liver than males at 22 weeks of age and had a higher proportion of gizzard than males at 26 and 30 weeks of age ($P<0.05$). On the other hand, males had a significantly higher proportion of heart than capons and females at all weeks of age ($P<0.05$). Females had a higher proportion of abdominal fat than capons and males at 22 weeks of age, and had a significantly higher proportion of abdominal fat than males at 26 weeks of age ($P<0.05$). There was no significant difference among the three groups at 30 weeks of age in the proportion of abdominal fat. Capons had significantly heavier abdominal fat weight than males at 26 week of age ($P<0.05$), although there was no significant difference in the proportion of abdominal fat at all weeks of age.

Discussion

In the live weights after 18 weeks of age, there was no significant difference between capons and males. This result was the opposite to previous studies which reported that capons were heavier than males (Akter *et al.,* 1996; Chen *et al.,* 2000a; Mast *et al.,* 1981; Rahman *et al.,* 2004; Welter, 1976). On the other hand, Ono *et al.* (1979) reported that the live weights of capons in New Hampshire at 30 weeks of age or Barred Plymouth Rock at 31 weeks of age were almost equal to that of males. Moreover, York and Mitchell (1969) and Cason *et al.* (1988) reported that the live weight of capons in broiler was significantly poorer than that of males. The different growth response of capons is probably due to the differences in strains, caponization age, caponization method, slaughtering age, and feed regimen. In the present study, male Hinai-jidori chicks were caponized at 8 week of age. Since the live body weight was heavy, the membrane around the testes was thick, and the artery was pulled when the testes were removed, it unfortunately took time for caponization. Resultantly, caponization greatly gave birds the stress. Thus, the reason that there was no significant difference between capons and males in the live weight is thought to be the decrease of the daily weight gain during 4–10 weeks of age by the stress. It should be considered to develop an efficient caponization method at the earlier stage and reduce the stress of caponization. Since capons gained more weight than males from 10 to 18 weeks of age in the present study, it is suggested that capons will gain more body weight if the stress by caponization is reduced. It is suggested that 26 weeks is better than 30 weeks for the feeding period, because the daily weight gain of capons was poorer than that of males after capon reach about 4,000 g.

As for the carcass traits, caponization changed greatly the proportion of muscles and organs that make up the live weight in capons as compared with males in the present study. The proportion of whole leg meat of capons significantly decreased more than males at all weeks of age. Ono *et al.* (1982) reported that caponization had a remarkable effect on muscle growth, with the conspicuous depression of the growth of leg muscle. This is due to the retardation of special muscle growth as the result of the lack of androgen secretion from the testes. As shown in Figure 1, caponization decreased the blood testosterone concentration in capons as compared with males and the blood testosterone concentration of capons changed in the same concentration as females. Thus, similar result is obtained as reported by Ono *et al.* (1982).

Ono *et al.* (1979) reported that there was no effect on the growth of viscera. However, caponization influenced

Table 3. **Comparisons of females, capons and capons on carcass traits of Hinai-jidori chicken at 22, 26 and 30 weeks of age**

Week		Live body weight (A)	Meat			
			Leg meat (B)	Breast meat (B)	Tender meat (B)	total (B)
22 W	Female (g)	2428±80[b]	478.0±21.3[c]	291.6± 3.4[b]	78.2±2.4[b]	847.8±24.5[b]
	(%)		19.7± 0.3[b]	12.0± 0.3[a]	3.2±0.2	34.9± 0.3[b]
	Capon (g)	3191±72[a]	642.8±20.2[b]	333.8±12.7[a]	104.4±5.7[a]	1081.0±35.7[a]
	(%)		20.1± 0.2[b]	10.4± 0.2[b]	3.3±0.1	33.8± 0.4[c]
	Male (g)	3240±188[a]	755.0±47.6[a]	329.8±14.3[a]	102.2±4.6[a]	1187.0±65.1[a]
	(%)		23.3± 0.3[a]	10.2± 0.2[b]	3.2±0.1	36.7± 0.3[a]
26 W	Female (g)	2506±110[b]	484.8±20.3[b]	294.6± 7.8[c]	83.8±1.9[c]	863.2±26.8[b]
	(%)		19.4± 0.3[c]	11.8± 0.4[a]	3.4±0.1	34.5± 0.8[b]
	Capon (g)	3827±121[a]	825.8±37.5[a]	444.8± 9.2[a]	131.0±2.6[a]	1401.6±47.5[a]
	(%)		21.6± 0.5[b]	11.6± 0.1[a]	3.4±0.1	36.6± 0.5[a]
	Male (g)	3669±139[a]	859.0±39.6[a]	391.0±19.6[b]	116.4±6.3[b]	1366.4±63.5[a]
	(%)		23.4± 0.3[a]	10.6± 0.1[b]	3.2±0.1	37.2± 0.4[a]
30 W	Female (g)	3008±78[c]	560.6±22.1[c]	350.8±10.9[b]	90.0±1.4[b]	1001.4±32.6[c]
	(%)		18.7± 0.3[c]	11.7± 0.2	3.0±0.1	33.4± 0.2[c]
	Capon (g)	3926±87[b]	826.4±26.5[b]	466.6±13.0[a]	129.6±7.3[a]	1422.6±40.3[b]
	(%)		21.0± 0.3[b]	11.9± 0.3	3.3±0.2	36.2± 0.2[b]
	Male (g)	4262±78[a]	1007.4±21.3[a]	477.2±14.2[a]	139.8±7.1[a]	1624.4±41.3[a]
	(%)		23.6± 0.4[a]	11.2± 0.2	3.3±0.2	38.1± 0.2[a]

Table 3. **(Continuation) Comparisons of females, capons and capons on carcass traits of Hinai-jidori chicken at 22, 26 and 30 weeks of age**

Week		Viscera			Abdominal fat (B)
		Liver (B)	Heart (B)	Gizzard (B)	
22 W	Female (g)	35.5±3.6[b]	8.7±0.3[c]	60.3±4.7	105.8±26.2[a]
	(%)	1.5±0.1[ab]	0.4±0.0[b]	2.5±0.2[a]	4.3± 1.0[a]
	Capon (g)	48.9±2.2[a]	12.7±0.3[b]	68.7±6.1	53.2± 6.4[b]
	(%)	1.5±0.0[a]	0.4±0.0[b]	2.2±0.2[ab]	1.7± 0.2[b]
	Male (g)	41.0±1.9[ab]	15.4±0.9[a]	54.1±5.4	27.0± 4.9[b]
	(%)	1.3±0.1[b]	0.5±0.0[a]	1.7±0.1[b]	0.8± 0.1[b]
26 W	Female (g)	38.1±3.7[b]	8.5±0.4[c]	53.9±4.8[b]	91.0±16.0[ab]
	(%)	1.5±0.1	0.3±0.0[b]	2.2±0.2[a]	3.6± 0.5[a]
	Capon (g)	49.1±2.8[a]	12.9±0.4[b]	88.3±4.9[a]	104.4±18.9[a]
	(%)	1.3±0.1	0.3±0.0[b]	2.3±0.1[a]	2.7± 0.5[ab]
	Male (g)	47.8±1.9[a]	19.3±0.8[a]	61.2±5.6[b]	50.4±12.8[b]
	(%)	1.3±0.0	0.5±0.1[a]	1.7±0.0[b]	1.4± 0.4[b]
30 W	Female (g)	61.6±7.6[a]	9.4±0.7[c]	43.8±1.7[c]	137.8±25.3
	(%)	2.0±0.1[a]	0.3±0.0[b]	1.5±0.0[b]	4.5± 0.7
	Capon (g)	46.3±1.4[b]	12.6±0.3[b]	84.4±4.2[a]	146.2±21.8
	(%)	1.2±0.0[b]	0.3±0.0[b]	2.1±0.1[a]	3.7± 0.5
	Male (g)	49.8±2.3[ab]	19.6±0.4[a]	61.9±4.1[b]	137.6±47.2
	(%)	1.2±0.1[b]	0.5±0.0[a]	1.5±0.1[b]	3.2± 1.0

Mean±S.E. ($n=5$).

[a, b, c] Means within the same column with different superscripts within the same week are significantly different ($P<0.05$).

%: B (weight of each part)/A (fast body weight).

the growth of internal organs in the present study. Caponization decreased significantly the proportion of heart in capons as compared with males. Fennel and Scanes (1992) observed that a dosage of androgen increased the heart weight. It is suggested that the decrease of the heart percentage in capons is due to the testosterone deficiency in the present study. Caponization also increased significantly the proportion of gizzard in capons as compared with males. It is suggested that the increase of feed intake influenced the proportion of gizzard because capons gained significantly more weight than males from 10 to 18 weeks of age. Our data suggests that caponization has a remarkable effect not only on the growth of whole leg meat, but also on the growth of the viscera, i.e., heart and gizzard.

There was no significant difference between capons and males in the proportion of abdominal fat at all weeks of age. However, when the abdominal fat weight is compared, capons had heavier abdominal fat weight than males at 26 week of age, which is in agreement with previous studies (Cason *et al.,* 1988; Chen *et al.,* 2000ab, 2005; Fennel and Scanes, 1992; Ono *et al.,* 1979). The abdominal fat accumulation is suggested to be due to the decrease of testosterone concentration after caponization. Ono *et al.* (1979) also reported caponization increases not only abdominal fat weight but also subcutaneous and intermuscular fat weight as compared with males. This result suggests that capons have more fat in the meat than males, although we did not observe subcutaneous and intermuscular fat weight in the present study.

In conclusion, capons gain the live body weight comparable to males and gain the abdominal fat weight comparable to females. Moreover, capons have advantages as compared with females, because capons had significantly higher proportion of whole leg and total meat. Thus, caponization can make unused male chicks usable in the production of Hinai-jidori chickens.

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