Research Note

An efficient method of early caponization in slow-growing meat-type chickens

K. Rikimaru,*[1] H. Takahashi,† and M. A. Nichols‡

*Livestock Experiment Station, Akita Prefectural Agriculture, Forestry and Fisheries Research Center, Jin-guji, Daisen 019-1701, Akita, Japan; †Animal Breeding and Reproduction Research Team, National Institute of Livestock and Grassland Science, Ikenodai 2, Tsukuba 305-0901, Ibaraki, Japan; and ‡Wapsie Produce Inc., Decorah, IA 52101

ABSTRACT We developed a new tool for testectomy and investigated the efficiency with regard to caponizing time and growth performance in Hinai-jidori chickens, a popular breed of chicken in Japan. Hinai-jidori chicks were divided into 2-, 4-, and 8-wk caponized groups and an intact male group (20 birds/group) at 2 wk of age and were raised until 26 wk of age. The testes of the male chicks caponized at 8 wk of age were surgically removed from both sides using a Japanese traditional tool, whereas those of male chicks caponized at 2 and 4 wk of age were surgically removed from only one side using the new tool. Using the traditional method, caponization of an 8-wk-old chick was achieved in 324.6 s (5 min 24 s), whereas using the new method, caponization of 2- and 4-wk-old chicks was achieved in only 35.9 and 28.4 s, respectively. Moreover, at 10 and 18 wk of age, the chicks caponized at 4 wk of age were significantly heavier than the chicks caponized at 8 wk of age. The data suggest that the decrease in the daily weight gain caused by caponization at a younger age was less than that at an older age. We concluded that early caponization shortens the caponizing time significantly and improves the decrease in the daily weight gain after caponization, thereby enabling efficient capon production from slow-growing meat-type chickens at early stages of development.

Key words: caponization, caponization age, caponizing time, growth performance, Hinai-jidori chicken

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INTRODUCTION

Capons are male chickens whose testes have been surgically removed. Because of the resultant deficiency of androgen production, caponized cockerels lack the characteristic large comb and wattles associated with sexually mature roosters. In capons, the energy that is usually expended in fighting, courting behavior, and territorial protection is greatly reduced, thereby allowing a highly efficient conversion of feed into growth, fat deposition, and improved meat quality (Jacob and Mather, 2000). Therefore, the meat of capons is more tender (Mast et al., 1981), juicier, and tastier (York and Mitchell, 1969) than that of a normal rooster.

Capons have been produced from heavy breeds such as Jersey Giants, Brahmas, Orpingtons, Cornish, Plymouth Rocks, Cochins, or Cornish × Plymouth Rock cross that are typically used by the commercial broiler industry (Jacob and Mather, 2000). However, recent studies have been performed in various regions on capons of slow-growing local chickens rather than broilers because capons from heavy breeds weigh 5 or 6 kg, which exceeds the commercial weight for home consumption, and consumers demand better quality of meat (Chen et al., 2000; Rahman et al., 2004; Miguel et al., 2008; Rikimaru et al., 2009a; Sirri et al., 2009).

Typically, male chicks of heavy breeds are caponized at 2 to 4 wk of age. At this age, heavy breeds should weigh approximately 450 g (Jacob and Mather, 2000). On the other hand, most of the slow-growing meat-type chickens are caponized after 6 wk of age (Chen et al., 2000; Miguel et al., 2008; Rikimaru et al., 2009b; Sirri et al., 2009) because these chickens take longer to gain the recommended BW for testectomy. However, the tunica albuginea of the testes becomes hard when the birds are caponized at later stages, and this makes removing the testes a more difficult and time-consuming procedure (Rikimaru et al., 2009b). As a result, the BW of capons is lower than that of noncastrated male chickens for some weeks after caponization (Lin and Hsu, 2002; Muriel, 2004; Rikimaru et al., 2009b). Therefore, it is necessary to develop an efficient method for caponization that can be performed in a short time in chickens at an early age. We performed this study to investigate the effects of caponization at different ages and the influence of the method of caponization on caponizing time and growth performance of a slow-

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[1]Corresponding author: Rikimaru-Kazuhiro@pref.akita.lg.jp

growing Japanese breed of chicken, Hinai-jidori, which is a cross between Hinai-dori (a breed native to the Japanese Akita prefecture) sires and Rhode Island Red dams (Rikimaru and Takahashi, 2007).

MATERIALS AND METHODS

Birds and Experimental Design

All animals received humane care as outlined in the Guidelines for Proper Conduct of Animal Experiments (Science Council of Japan, 2006). The procedure of experiment in this study was performed in accordance with the guidelines of FASS (2010).

Male Hinai-jidori chicken supplied by Akita Prefectural Agriculture, Forestry and Fisheries Research Center, Livestock Experiment Station (Daisen, Akita, Japan) were raised in temperature-controlled, wire-floored, 4-tier battery cages until they were 4 wk old. Thereafter, these chicks were raised in an open-sided poultry shed with access to a grass paddock until they were 26 wk old. We assigned 20 male chicks at 2 wk of age to each of the 4 groups: 1) caponized at 2 wk of age, 2) caponized at 4 wk of age, 3) caponized at 8 wk of age, and 4) uncastrated males. Feed (Table 1) and water were provided ad libitum.

Caponization Method

Caponization was performed in the presence of a veterinarian in accordance with accepted veterinary practices. Birds were caponized without being anaesthetized because the purpose of this study was to scientifically verify how the method affects caponizing time and BW gain after caponization, and the use of anesthesia would prevent collection of data applicable to the commercial poultry industry situation.

The chicks of the 2-, 4-, and 8-wk caponized groups were caponized at 2, 4, and 8 wk of age, respectively. Before caponization, all intact male chicks were deprived of feed for 16 h to avoid excessive bleeding during surgery and to increase the prominence of the testes, thereby facilitating their removal. Water was provided ad libitum during the fast period. The caponizing tools (spreader and forceps) used in this study are shown in Figure 1 (traditional type in panel A; new type in panel B). The traditional tool in Japan (referred to as tool A; FE30, Fujihira Industry Co., Tokyo, Japan) was used for chicks of the 8-wk caponized group as described by Rikimaru et al. (2009b). Tool A was too large to be used to caponize 2- and 4-wk-old Hinai-jidori male chickens, so it could be used only at 8 wk of age. Therefore, we improved a testectomy tool (referred to as tool B; Natsume Seisakusho Co., Tokyo, Japan) for young birds and used it for the 2- and 4-wk caponized groups. The tip of the forceps of tool A is a spoon type and is 19 mm wide, whereas that of tool B is a loop type, 12 mm wide, and is smaller than that of tool A (Figure 1). Because of the structure of the forceps of tool B, the inner part of the body is visible and both testes can be removed from one side. When using the spreader of tool A, one needs to use both hands for widening the incision between the ribs and cannot control the width, whereas the width can be controlled with a single hand when using tool B.

We prepared a simple table that was set at an angle to permit the direct entry of light into the body cavity of the bird and to enable the operator to work with greater ease. The chicks were initially fastened to a clean wooden work surface on the table. The wings and legs were fastened and the bird was stretched to its full length to expose the rib cage area. The down feathers of the chicks of the 8-wk caponized group were removed from the lateral region just anterior to the thigh. The chicks of the 2- and 4-wk caponized groups were featherless. The skin over the ribs was disinfected with 70% ethanol. The skin was drawn toward the hip, and the first finger of the left hand was placed over the right hip located below the last ribs. Then, holding the knife in the right hand, an incision was made between the last 2 ribs, which were widened using a spreader.

The testes of the chicks in the 8-wk caponized group were removed from both sides through the last 2 ribs by using caponizing forceps. The testis was placed be-

Table 1. Ingredient composition and calculated analysis of the feed

Item (% unless noted)	Starter (2–4 wk)	Grower (4–10 wk)	Finisher (10–26 wk)
Ingredient			
Yellow corn, Kaoliang[1]	53	65	66
Soybean oil cake and rapeseed oil cake	34	25	23
Wheat bran	0	5	7
Fish meal	6	2	1
Others[2]	7	3	3
Total	100	100	100
Calculated nutrient content			
ME (kcal/kg)	3,000	2,850	2,900
CP	24	18	16
Ca	0.8	0.65	0.75
Available P	0.6	0.55	0.55

[1]Kaoliang is a *Sorghum vulgare*.

[2]Vitamin-mineral premix, animal oil, alfalfa meal, calcium phosphate, calcium carbonate, salt, silicic acid, and isomalto-oligosaccharide syrup.

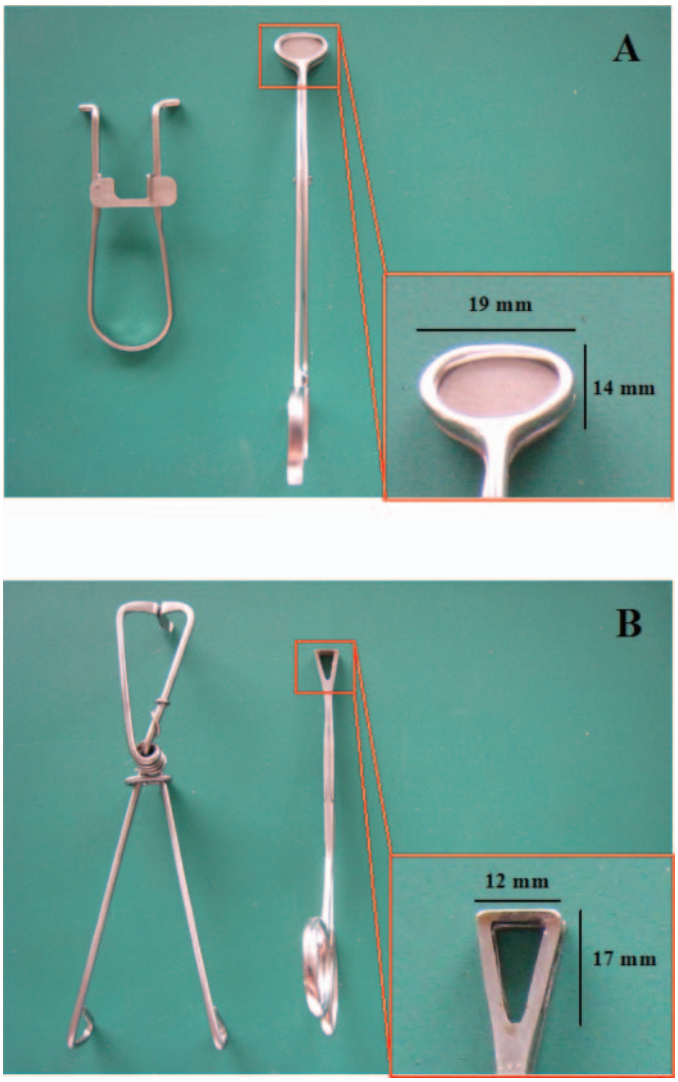

Figure 1. Caponizing tools (left: spreader; right: forceps). A) Traditional-type tool. B) New-type tool. Color version available in the online PDF.

tween the forceps and was gently twisted to one side to prevent damage to the blood vessels surrounding the testis. Then, the chicks were turned so that the opposite side of the body faced the table and the other testis was removed using the same method. The testes of the chicks in the 2- and 4-wk caponized groups were removed from only one side (Figure 2). The chicks were placed on the board with the left side facing downwards and an incision was made between the last 2 ribs, which were widened using a spreader. First, the lower testis was lifted with the forceps and the forceps were gently opened and drawn toward the operator. When the testis dropped past the upper jaw of the forceps, the lower jaw was quickly extended toward the posterior end of the chicks to lodge the testis on the lower jaw. The jaws of the forceps were squared on the testis and closed on the upper and lower sides of the tissues that connect the testis to the body. Then, the jaws were closed, locked, and pulled with a twisting motion until the testis was severed from the body. Next, the upper testis was grasped with the forceps and removed in a similar manner.

After removing the spreader, the wound was disinfected with 70% ethanol and closed without sutures because the skin and thigh muscle returned to their original position and served as a natural bandage over the incision between the ribs. After surgery, the birds were provided with feed and water in a clean pen in which they were confined for 1 wk. After 1 wk, the air accumulated under the skin was released by carefully puncturing the skin with a sharp instrument.

Caponizing Time and Growth Performance

The caponization of the chicks of the 2-, 4-, and 8-wk caponized groups was individually timed from the time of incision to time of testes removal by using a stopwatch. The BW of all chicks was measured at 2, 4, 8, 10, 14, 18, 22, and 26 wk of age. The daily weight gain was calculated on the basis of the changes in BW. The feed conversion was calculated on the basis of the daily weight gain and feed intake. Slips (incomplete caponization) were identified by necropsy at 26 wk of age.

Statistical Analysis

All statistical analyses were performed by Social Survey Research Information (Tokyo, Japan) using Statistics 2006 software (Excel, Microsoft Corp., Redmond, WA). The treatment means were compared using the software for multiple comparison tests of Tukey's, Bonferroni's, and Sheffe's methods. The differences among the groups were considered significant if P-values less than 0.05 were obtained in all the multiple comparison tests.

RESULTS AND DISCUSSION

The caponizing time of the chicks in the 2-, 4-, and 8-wk caponized groups is shown in Table 2. The caponizing time in the 8-wk caponized group, in which tool A was used, was 324.6 s (5 min 24 s). In contrast, the caponizing time in the 2- and 4-wk caponized groups, in which tool B was used, was significantly shortened to only 35.9 and 28.4 s, respectively. The duration in the latter 2 groups was shorter ($P < 0.01$) than that in the former group. The caponizing time in the 2- and 4-wk caponized groups was not significantly different.

The growth performance of the chicks in the 2-, 4-, and 8-wk caponized groups and the intact group is shown in Table 3. The number of deaths in the 4-wk caponized group was only 1 bird despite early caponization. The results of necropsy indicated that 4 birds in the 2-wk caponized group and 3 birds in the 4-wk caponized group were incompletely caponized and the testes had partially regenerated. Thus, data for the slips were not used in the analysis. The chicks in the 4-wk caponized group were heavier ($P < 0.05$) than those in the 8-wk caponized group at 10 and 18 wk of

Figure 2. Caponization using tool A or tool B as shown in Figure 1. Tool A: traditional tool used in Japan (tip of the forceps is a spoon type and is 19 mm wide); tool B: improved tool (tip of the forceps is a loop type, 12 mm wide). A) Caponization from both sides using tool A at 8 wk of age. B) Caponization from one side using tool B at 2 wk of age. Arrows indicate testis. Color version available in the online PDF.

age. No significant differences were found among the BW of the 2-wk caponized, 4-wk caponized, and intact groups at any stages. After the chicks were 22 wk old, the BW of all groups was not significantly different. In the daily weight gain from 2 to 14 wk of age, the chicks in the 4-wk caponized group gained the most weight whereas those in the 8-wk caponized group gained the least weight. Moreover, the chicks in the 2- and 4-wk caponized groups gained more weight than those in the 8-wk caponized group across the experiment period (2 to 26 wk of age). Few differences were found in the feed intake and feed conversion of the chicks of all groups except that the feed intake in the 8-wk caponized group showed a tendency to decrease at 14 to 26 wk of age.

The main reason for the difference in the caponizing time was the use of an improved tool. As a result, it was possible to remove both testes from only one side. Because no significant differences were found among the chicks of the 2-wk, 4-wk, and intact groups with regard to growth performance, caponization at the early age with the new tool is suggested to be better than at the later stage with the traditional tool.

Table 2. Effects of caponization age and tool on caponizing time in Hinai-jidori chickens[1]

	Caponization age (wk)		
Item	2	4	8
n	20	20	20
Caponizing tool[2]	B	B	A
BW at caponization, g	114.9 ± 11.2[c]	334.3 ± 28.6[b]	985.2 ± 152.8[a]
Caponizing time, s	35.9 ± 9.6[b]	28.4 ± 6.7[b]	324.6 ± 57.0[a]

[a–c]Means within a row with different superscripts are significantly different ($P \leq 0.01$).

[1]Values are mean ± SD.

[2]Tool A: traditional tool used in Japan (tip of the forceps is a spoon type and is 19 mm wide); tool B: improved tool (tip of the forceps is a loop type, 12 mm wide).

Many studies have described the effects of caponization on growth performance, but the results of these studies are inconsistent. The effect of caponization on BW may be influenced by factors such as age at caponization, age at slaughter, and species or strain differences, as reported by Cason et al. (1988). In broilers, caponization at 3 wk of age resulted in lower BW of capons at 7 wk of age when compared with intact males (Cason et al., 1988). In particular, this group mentioned that surgical stress is an important consideration in caponization because intact controls were significantly heavier than sham-operated controls. In local breeds, the response of caponization appears to be different. In the Extremeña Azul chicken native to Spain, birds caponized at 60 to 64 d of age were significantly less heavy than roosters at 11 wk of age, but the capons had become significantly heavier than the roosters at 20, 25, and 30 wk of age (Muriel, 2004). In Taiwan country chickens, intact male birds had significantly lower BW before 14 wk of age whereas birds caponized at 10 wk of age had significantly higher BW after 18 wk of age (Lin and Hsu, 2002). These data suggest that surgical stress induced at caponization greatly influences the daily weight gain in the subsequent weeks. However, caponized chicks recovered from the effects of the operation and they gained more weight than intact males.

In this study, chicks caponized at 2 and 4 wk of age using tool B recovered rapidly and gained weight similar to intact males. In contrast, chicks caponized at 8 wk of age using tool A did not gain as much weight as the chicks in the other experimental groups during 2 to 14 wk. Two possible reasons why chicks caponized at 8 wk of age could not recover sooner are 1) caponization

Table 3. Effects of caponization age and tool on growth performance in Hinai-jidori chickens[1]

	Caponization age (wk)			
Item	2	4	8	Intact
n	20	20	20	20
Caponizing tool[2]	B	B	A	
Mortality	0	1	0	0
Slip	4	3	0	—
BW,[3] g				
2 wk old	115 ± 11	115 ± 11	114 ± 11	116 ± 11
4 wk old	306 ± 34	336 ± 32	319 ± 31	329 ± 31
8 wk old	944 ± 127	1,088 ± 181	985 ± 153	967 ± 138
10 wk old	1,419 ± 144[ab]	1,547 ± 217[a]	1,342 ± 162[b]	1,444 ± 163[ab]
14 wk old	2,299 ± 187	2,455 ± 293	2,229 ± 172	2,346 ± 228
18 wk old	3,052 ± 235[ab]	3,214 ± 244[a]	2,933 ± 258[b]	3,146 ± 239[ab]
22 wk old	3,615 ± 344	3,787 ± 282	3,553 ± 285	3,753 ± 279
26 wk old	4,071 ± 279	4,175 ± 363	3,943 ± 338	4,170 ± 291
Weight gain,[3] g/bird per day				
2 to 14 wk old	26.0 ± 2.1	27.9 ± 3.5	25.4 ± 1.7	26.5 ± 2.6
14 to 26 wk old	21.2 ± 3.8	20.5 ± 3.5	20.6 ± 2.9	22.0 ± 2.6
Feed intake,[4] g/bird per day				
2 to 14 wk old	82.8	84.2	82.0	86.7
14 to 26 wk old	165.5	165.1	152.4	165.9
Feed conversion,[4] g of feed/g of gain				
2 to 14 wk old	3.2	3.0	3.2	3.3
14 to 26 wk old	7.8	8.1	7.4	7.5

[a,b]Means within the same row without the same superscript letter are significantly different ($P \leq 0.05$).

[1]Values are mean ± SD.

[2]Tool A: traditional tool used in Japan (tip of the forceps is a spoon type and is 19 mm wide); tool B: improved tool (tip of the forceps is a loop type, 12 mm wide).

[3]Means except slips.

[4]Means contain slips. No analysis because of no individual data.

at an early developmental stage may be better than caponization at a later stage, and 2) stress caused by caponization reflected by the longer caponizing time may have affected the recovery. Chen et al. (2007) reported that early caponization (at 3 wk of age) significantly increased the BW of chicken at 16 wk of age compared with the sham-operated male chicken. Shao et al. (2009) also reported that surgical stress had no significant detrimental effects on the growth of capons because they did not observe any significant differences among intact, sham-operated, and capon groups; moreover, they proposed that sexual maturity had a greater influence on growth than surgical stress. These reports suggest that the effect of the age at caponization is greater than the effect of surgical stress.

In this study, several slips were observed in the 2- and 4-wk caponized groups. In general, 5 to 20% slips are produced even when the surgery is performed by an experienced technician (Chen et al., 2006). Slips show more significant secondary male sexual characteristics than capons (Mast et al., 1981; Chen et al., 2006). Moreover, the quality of the meat of slips is intermediate between that of capons and cocks (Mast et al., 1981; Sirri et al., 2009); therefore, slips are not favored or accepted as capons by consumers, thereby leading to a huge loss in revenue (Chen et al., 2006). Further examination of the caponization method should be conducted to decrease the incidence of slips. In this study, we found that early caponization with the new tool shortened the caponizing time and improved the decrease in the daily gain after caponization. To obtain a high percentage of capons, both the testicles and the peritoneal membrane surrounding the gonads, the epididymis, and the anterior portion of the vas deferens should be removed.

In conclusion, we described an efficient method for testectomy applicable in small chicks in which the caponizing time was significantly shortened. This method will greatly enhance the production of capons of the Hinai-jidori breed and of other breeds.

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REFERENCES

Cason, J. A., D. L. Fletcher, and W. H. Burk. 1988. Effect of caponization on broiler growth. Poult. Sci. 67:979–981.

Chen, K. L., T. T. Chen, K. J. Lin, and P. W. S. Chiou. 2007. The effects of caponization age on muscle characteristics in male chicken. Asian-australas. J. Anim. Sci. 20:1684–1688.

Chen, K. L., T. Y. Hsieh, and P. W. S. Chiou. 2006. Caponization effects on growth performance and lipid metabolism in Taiwan country chicken cockerels. Asian-australas. J. Anim. Sci. 19:438–443.

Chen, K. L., C. P. Wu, and Y. M. Hong. 2000. Meat quality and carcass traits of capon in comparison with intact male and female Taiwan country chickens. J. Chin. Soc. Anim. Sci. 29:77–88.

FASS. 2010. Guide for the Care and Use of Agricultural Animals in Research and Teaching. 3rd ed. Federation of Animal Science Societies, Champaign, IL.

Jacob, J., and F. B. Mather. 2000. Capons. Factsheet PS-54. Department of Animal Science, Florida Cooperative Extension Service, Institute of Food and Agricultural Service, University of Florida, Gainesville.

Lin, C. Y., and J. C. Hsu. 2002. Effects of surgical caponization on growth performance, fiber diameter and some physical properties of muscles in Taiwan country chicken cockerels. Asian-australas. J. Anim. Sci. 15:401–405.

Mast, M. G., H. C. Johdan, and J. H. Macneil. 1981. The effect of partial and complete caponization on growth rate, yield, and selected physical and sensory attributes of cockerels. Poult. Sci. 60:1827–1833.

Miguel, J. A., J. Ciria, B. Asenjo, and J. L. Calvo. 2008. Effect of caponization on growth and on carcass and meat characteristics in Castellana Negra native Spanish chickens. Animal 2:305–311.

Muriel, A. 2004. The effect of caponization on production indices and carcass and meat characteristics in free-range Extremeña Azul chickens. Span. J. Agric. Res. 2:211–216.

Rahman, M. M., M. A. Islam, M. Y. Ali, M. E. A. Khondaker, and M. M. Hossain. 2004. Effect of caponization on body weight, hematological traits and blood cholesterol concentration of Nara chicken. Int. J. Poult. Sci. 3:284–286.

Rikimaru, K., S. Ogawa, M. Komatsu, and J. Ishizuka. 2009a. Effects of caponization on meat quality of Hinai-jidori chicken. Jpn. Poult. Sci. 46:345–350.

Rikimaru, K., and H. Takahashi. 2007. A method for discriminating a Japanese brand of chicken, the Hinai-jidori, using microsatellite markers. Poult. Sci. 86:1881–1886.

Rikimaru, K., M. Yasuda, M. Komatsu, and J. Ishizuka. 2009b. Effects of caponization on growth performance and carcass characteristics in Hinai-jidori. Jpn. Poult. Sci. 46:351–355.

Science Council of Japan. 2006. Guidelines for Proper Conduct of Animal Experiments. Science Council of Japan, Tokyo.

Shao, Y., C. Wu, J. Li, and C. Zhao. 2009. The effects of different caponization age on growth performance and blood parameters in male Tibetan chicken. Asian J. Anim. Vet. Adv. 4:228–236.

Sirri, F., M. Bianchi, M. Petracci, and A. Meluzzi. 2009. Influence of partial and complete caponization on chicken meat quality. Poult. Sci. 88:1466–1473.

York, L. R., and J. D. Mitchell. 1969. The effect of estradiol-17β-monopalmitate and surgical caponization on production efficiencies, yields and organic characteristics of chicken broilers. Poult. Sci. 48:1532–1536.