The effect of caponization on production indices and carcass and meat characteristics in free-range Extremeña Azul chickens

A. Muriel Durán*
Servicio de Investigación y Desarrollo Tecnológico. Junta de Extremadura. 06187 Guadajira (Badajoz). Spain

Abstract

This paper reports the effect of caponization on production indices and carcass and meat characteristics in free-range Extremeña Azul chickens. At 11 weeks, capon body weight was significantly lower than that of roosters (p < 0.05), although it was similar at slaughter. There were no significant differences in the corresponding percentages of abdominal fat and eviscerated carcass. However, the corresponding percentages of wings, breast and butchered portions (thighs + drumsticks + wings + breast) were significantly greater (p < 0.05) in capons. However, the corresponding percentages of neck, thighs + drumsticks, and the edible portion of the thighs + drumsticks were greater in roosters (p < 0.05). In tests involving 48 consumers, no significant differences were detected in capon and rooster meat organoleptic characteristics.

Key words: capons, roosters.

Introduction

Extremeña Azul chickens (Gallus gallus L.) are capable of living outdoors but show scant body development. Although this breed is not officially recognised, it does have a basic morphological pattern (Orozco, 2000), there is an aviculture association (in Extremadura, Spain) interested in its rearing, and it is in demand as a pet by owners of country houses.

The native breeds of Extremadura are considered part of the region’s identity; they therefore enjoy protection and their rearing is encouraged. For this reason, the Research and Technological Development Dept. of the Extremadura Regional Government (Servicio de Investigación y Desarrollo Tecnológico de la Junta de Extremadura) maintains the Valdesequera Farm in Badajoz. This facility has a population of Extremeña Azul chickens, the morphology and productive capacity of which have been the subject of research since the year 2000 (Muriel, 2002). The intention is to encourage the rearing of this breed not only as a leisure activity but as a commercial concern.

Free-range chickens are a production alternative to intensive exploitation (Muriel et al., 1997). However, the market for speciality products such as poullards, country chickens, ecological chickens, picantones and capons is very small, with peak demand normally at Christmas.

According to CEE regulation no. 1000/96 (OJ, 1996), a capon is a male chicken that has been surgically...
castrated before having reached sexual maturity, and slaughtered at a minimum age of 140 days. Once castrated, capons must be subjected to a minimum fattening period of 77 days.

In capon production, light-weight, middle-weight or heavy-weight chicken breeds or strains can be used. In Spain, the following native breeds are currently used in capon production: Catalana del Prat (BOE, 1991), Penedesenc Negra (Cubiló et al., 2000a), Ampurdanesa Roja (Cubiló and Tor, 1999a), Mos (Sánchez et al., 1995, 2000), Castellana Negra (Ciria et al., 2002 a and b) and several Andalusian breeds (Villena et al., 2002). This industry contributes to the conservation of chicken genetic resources. Similar use is made of native breeds in France (e.g., of the Bresse or Géline de Loué breeds) and in Hungary (Barna et al., 1995).

Few studies have examined the effects of castration on bird growth and carcass and meat characteristics through the comparison of these variables in capons and roosters. The aim of the present work was to perform such a comparison in free-range Extremeña Azul poultry.

**Material and Methods**

**Animals and their management**

The starting material consisted of 400 non-sexed Extremeña Azul chicks with a mean birth weight of 37.5 g. Each bird was identified with a metallic band on the wing membrane.

The chicks were raised following European legislation for the production of traditional free-range animals (OJ, 1991), living outside from the age of six weeks. Until this time they lived in a 50 m² henhouse with electrical heating. Continuous lighting was provided during the first week of life, after which natural light was made available.

At six weeks the chicks were sexed and the males transferred to open corrals on the Valdesequera Farm (Badajoz). One hundred were randomly selected for caponization and 84 were left untouched to act as controls. These were separately placed in 500 m² corrals, each with a metal-frame shelter. The birds were raised between March and November of 2002. During this time they lived outside, the maximum and minimum temperatures recorded were 44°C (in June) and 3°C (in October).

At 60-64 days of age, the 75 males still available in the caponization group were surgically castrated by testicular strangulation (intercostal approach) (Van der Horst, 1997).

The birds were fed *ad libitum*. Until the age of six weeks, a ground feed was provided, but from this moment until slaughter they were fed granulated 70% cereal feed. Table 1 shows the chemical composition of these feeds.

Water was also provided *ad libitum* from manually or automatically-filled troughs. At 228 days of age, 70 capons and 44 roosters were taken to slaughter in Talavera La Real (province of Badajoz). In the preceding week, these birds were fed their normal feed but without coccidiostatic additives. Thirty capons and 30 roosters were reserved for the study of their carcasses while the remainder, prepared as eviscerated carcasses without heads or feet, were destined for test consumption to determine consumer acceptability.

**Monitoring of variables**

Individual weight and feed consumption were measured every two weeks for the first six weeks. The last body measurements before caponization were taken at eight weeks. From this time on, the birds were weighed and feed consumption determined at 11, 15, 20, 25, 30 and 32 weeks. All measurements were made using a Mettler PM 6000 weighing scale.

Carcass samples were frozen until use. Thawing was performed at refrigeration temperature in the Meat Laboratory at the La Orden Farm (Badajoz).

The metatarsus, head, edible viscera (liver, heart and crop) and body fat of the plucked capons and roosters were removed and weighed. The butchering method of the World Poultry Association European Federation (1984) was used. The legs were dissected, separating the meat from the edible product (lean meat, fat and

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**Table 1. Chemical composition of feeds**

<table>
<thead>
<tr>
<th></th>
<th>Starter feed</th>
<th>Fattening feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME (kcal kg⁻¹)</td>
<td>3,100</td>
<td>2,900</td>
</tr>
<tr>
<td>CP (%)</td>
<td>23.5</td>
<td>18.2</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>8.2</td>
<td>5.9</td>
</tr>
<tr>
<td>GF (%)</td>
<td>1.8</td>
<td>4.2</td>
</tr>
<tr>
<td>EE (%)</td>
<td>4.2</td>
<td>2.3</td>
</tr>
<tr>
<td>DM (%)</td>
<td>91.0</td>
<td>92.5</td>
</tr>
</tbody>
</table>

ME: metabolizable energy. CP: crude protein. GF: gross fibre. EE: ether extract. DM: dry matter. All values refer to fresh weight of product.
The testes of the roosters were also extracted, as were those that had regenerated in capons. A Cobos D-4000-CS balance was used to measure all carcass weights.

For the study of the meat, habitual chicken consumers were provided with 40 capon and 14 rooster carcasses plus a questionnaire for evaluating the following sensorial characteristics on a 1-10 scale: tenderness (1 = soft, 5 = mid range, 10 = very hard), juiciness (1 = very dry, 5 = mid range, 10 = very juicy), and flavour (1 = very poor, 5 = acceptable, 10 = excellent). The questionnaire included suggestions on how to prepare the meat. The consumers received no previous training. The number of rooster carcasses tested was only 14 since no more consumers were available for this part of the study. Thirty four completed forms were returned for the capon study, and 14 for the rooster study.

Statistical analysis

The results are presented as means, the standard error of the means, and variation coefficients. To evaluate the effect of caponization on the variables measured, the equation Y = µ + C + ε was used, where Y is the variable considered, µ the mean of the population, C the effect of caponization and ε the residual error. Means were compared using the LSD test. Significance was set at 0.05. All data were analysed using Statistica v.5 software (Statsoft, 2002).

Results

Table 2 shows the change in live weight from eight weeks (last measurement before caponization) until slaughter. At 11 weeks (the first weighing after caponization), the capons were significantly lighter than the roosters (p < 0.05), but at 15 weeks their weights had equalled. At 20, 25 and 30 weeks, the capons had become significantly heavier than the roosters. At slaughter, capon weight was only slightly greater than rooster weight (not significant).

The feed conversion index was slightly higher for the capons (7.83 compared to 7.32 for the roosters) since their feed consumption was greater (19.86 compared to 17.97) but the weights eventually reached by both types of bird were very similar. As a consequence, the cost of feed per kg live weight produced is somewhat higher for capons (1.87 eur compared to 1.75 eur).

As expected, significant differences (p < 0.001) were seen with respect to the effect of caponization on testicular weight. Sixty percent of the capons showed no signs of testicular remains. However, in the majority of the remaining 40%, regeneration of small testes were seen, although these were much lighter than normal rooster testes. The mean capon testicular weight was 2.88 g (mean of 30 birds; 18 with no testicular remains, 5 with remains of one testis, and 7 with remains of 2 testes), while that of roosters was 17.79 g.

Tables 3 and 4 show the effects of caponization on the carcass variables measured. Table 3 shows that capon metatarsus, wing and breast weights were significantly higher than those of roosters.

Table 2. Change in live weight (g) (mean ± standard error) of Extremeña Azul capons and roosters

<table>
<thead>
<tr>
<th>Age (weeks)</th>
<th>Capons</th>
<th>Roosters</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>748.40 ± 14.04</td>
<td>739.29 ± 12.02</td>
<td>NS</td>
</tr>
<tr>
<td>11</td>
<td>1,152.93 ± 24.42</td>
<td>1,213.65 ± 21.26</td>
<td>*</td>
</tr>
<tr>
<td>15</td>
<td>1,770.85 ± 25.79</td>
<td>1,729.13 ± 25.44</td>
<td>NS</td>
</tr>
<tr>
<td>20</td>
<td>2,171.37 ± 30.00</td>
<td>1,909.48 ± 27.43</td>
<td>***</td>
</tr>
<tr>
<td>25</td>
<td>2,352.29 ± 31.52</td>
<td>2,145.56 ± 32.29</td>
<td>***</td>
</tr>
<tr>
<td>30</td>
<td>2,553.40 ± 36.68</td>
<td>2,394.63 ± 36.65</td>
<td>*</td>
</tr>
<tr>
<td>32 + 4 days</td>
<td>2,575.67 ± 36.80</td>
<td>2,491.96 ± 37.59</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS: not significant. * p < 0.05. *** p < 0.001.

Table 3. Effect of caponization on carcass variables

<table>
<thead>
<tr>
<th>Weight (g)</th>
<th>Capons</th>
<th>Roosters</th>
</tr>
</thead>
<tbody>
<tr>
<td>At slaughter</td>
<td>2,613.23 ± 54.12</td>
<td>2,522.74 ± 45.17</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>110.30 ± 3.45</td>
<td>97.29 ± 2.63</td>
</tr>
<tr>
<td>Head</td>
<td>70.36 ± 3.12</td>
<td>82.91 ± 1.67</td>
</tr>
<tr>
<td>Edible viscera</td>
<td>75.72 ± 1.58</td>
<td>78.92 ± 1.57</td>
</tr>
<tr>
<td>Abdominal fat</td>
<td>37.00 ± 4.92</td>
<td>23.88 ± 4.55</td>
</tr>
<tr>
<td>Eviscerated carcass</td>
<td>1,908.58 ± 44.06</td>
<td>1,829.53 ± 33.17</td>
</tr>
<tr>
<td>Neck</td>
<td>130.36 ± 3.68</td>
<td>136.53 ± 3.52</td>
</tr>
<tr>
<td>Thighs and drumsticks</td>
<td>687.72 ± 17.77</td>
<td>681.32 ± 14.24</td>
</tr>
<tr>
<td>Wings</td>
<td>213.47 ± 4.84</td>
<td>195.39 ± 4.03</td>
</tr>
<tr>
<td>Breast</td>
<td>401.90 ± 11.36</td>
<td>348.25 ± 7.97</td>
</tr>
<tr>
<td>Rest of carcass</td>
<td>464.40 ± 9.84</td>
<td>461.73 ± 11.05</td>
</tr>
</tbody>
</table>

Table 4. Effect of caponization and breed on carcass variables

<table>
<thead>
<tr>
<th>Dissected thighs and drumsticks</th>
<th>Capons</th>
<th>Roosters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edible product</td>
<td>601.37 ± 15.79</td>
<td>602.21 ± 12.49</td>
</tr>
<tr>
<td>Bone</td>
<td>80.44 ± 2.62</td>
<td>71.58 ± 2.01</td>
</tr>
</tbody>
</table>

Figures with different letters in the same row are significantly different (p < 0.05).
greater than those of roosters (p < 0.05), while rooster heads were heavier than those of capons (p < 0.05). All other variables were similar.

Table 4 shows that all the variables, except for the percentage of live body weight made up by the abdominal fat and the eviscerated carcass, and the rest of the carcass as a percentage of the eviscerated carcass, were significantly influenced by caponization.

The percentage of eviscerated carcass weight made up by the wings, breast, and butchered portions (thighs + drumsticks + wings + breast) was significantly greater (p < 0.05) in the capons. The percentage of the eviscerated carcass weight made up by the neck and the thighs + drumsticks, however, was significantly greater (p < 0.05) in the roosters.

The differences in the dissected parts of the thighs + drumsticks, expressed as a percentage of the overall weight of these pieces, shows the percentage edible product to be greater (p < 0.05) in the roosters. With respect to these pieces, roosters therefore have proportionally less bone than do capons (p < 0.05).

Table 5 shows the results for the meat sensorial characteristics tested. No differences were found between capons and roosters. Tenderness, juiciness and flavour were judged to be favourable in both: both products were acceptable.

Discussion

Once the stress of the surgical procedure has been overcome, caponization seemed to have no negative effect on growth. Several authors have shown that for the same slaughter age, capon live weights are either similar (Zanusso et al., 2001) or greater than those of roosters (Mast et al., 1981; Tor et al., 1999; Cubiló et al., 2000b). In the present study, caponization only led to significantly inferior body weights at 11 weeks. This can be attributed to the pre-castration fast and the resulting stress caused by the procedure. The fact that the capons were significantly heavier at 20, 25 and 30 weeks might be due to the fact that the roosters were more aggressive at this stage (which actually led to their greater mortality). This was also observed by Zanusso et al. (2001).

Although in the present study the accumulated feed conversion index for the capons was only slightly higher than that of the roosters, it would appear that

![Table 4. Effect of caponization on carcass and leg dissection variables](image)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage (%)</th>
<th>Capons</th>
<th>Roosters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal fat</td>
<td>1.43 ± 0.19</td>
<td>0.94 ± 0.18</td>
<td></td>
</tr>
<tr>
<td>Eviscerated carcass</td>
<td>72.95 ± 0.28</td>
<td>72.54 ± 0.31</td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>6.84 ± 0.12b</td>
<td>7.46 ± 0.13a</td>
<td></td>
</tr>
<tr>
<td>Thighs + drumsticks</td>
<td>35.99 ± 0.21b</td>
<td>37.20 ± 0.24a</td>
<td></td>
</tr>
<tr>
<td>Wings</td>
<td>11.19 ± 0.07a</td>
<td>10.67 ± 0.07b</td>
<td></td>
</tr>
<tr>
<td>Breast</td>
<td>21.01 ± 0.31a</td>
<td>19.05 ± 0.29b</td>
<td></td>
</tr>
<tr>
<td>Rest of the carcass</td>
<td>24.40 ± 0.25a</td>
<td>25.25 ± 0.41a</td>
<td></td>
</tr>
<tr>
<td>Butchered portions</td>
<td>68.19 ± 0.29a</td>
<td>66.92 ± 0.40b</td>
<td></td>
</tr>
</tbody>
</table>

| Edible product                     | 88.20 ± 0.23b  | 89.40 ± 0.15a  |
| Bone                               | 11.80 ± 0.23a  | 10.60 ± 0.15b  |

1 With respect to live weight at slaughter. 2 With respect to the weight of the eviscerated carcass. 3 Sum of % (thighs + drumsticks) + % wings + % breast. 4 With respect to the weight of the thighs + drumsticks. Figures with different letters in the same row are significantly different (p < 0.05).

![Table 5. Sensorial characteristics of capon and rooster meat](image)

<table>
<thead>
<tr>
<th>Sensorial characteristics</th>
<th>Capons</th>
<th>Roosters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tenderness</td>
<td>Juiciness</td>
</tr>
<tr>
<td><strong>Capons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.68 ± 0.24</td>
<td>7.29 ± 0.30</td>
</tr>
<tr>
<td>cv (%)</td>
<td>24.82</td>
<td>24.01</td>
</tr>
<tr>
<td><strong>Roosters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>6.58 ± 0.40</td>
<td>7.50 ± 0.47</td>
</tr>
<tr>
<td>cv (%)</td>
<td>20.97</td>
<td>21.60</td>
</tr>
<tr>
<td>Significance</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

cv: coefficient of variation. NS: not significant.
castration improves this variable once castration stress has been overcome (Mast et al., 1981; Van der Horst, 1997; Francesch et al., 1998). However, if capons deposit more fat (which is generally considered to be the norm), it is difficult to see how the efficiency of feed utilisation is not altered by castration (Etches, 1996). In the present study, the greater feed consumption and reduction in utilisation efficiency in capons might be explained by the greater energy cost of fat deposition.

The caaponization procedure is not always successful and the testes regenerate in some animals. Cubiló and Tor (1999a) indicate that 8–9 weeks after castration, some capons show a reddening of the crest and wattle and make attempts to crow. The same authors (1999b) report that testicular regeneration is usually due to deficient surgery (perhaps because of operator inexperience), a deficient pre-surgery fast, performing the operation too quickly, or pre-operative dehydration. In the present study, the authors had no prior experience of performing castration by the technique used, and a high percentage of birds showed signs of regeneration. There were failures to extract at least one testis whole in some birds; rather, these testes were extracted in fragments and some remnants could have remained. Improving our expertise in this technique is an objective of future work.

With respect to the weight and percentage of abdominal fat, the present results are in agreement with those of Zanusso et al. (2001) who worked with an experimental line of chickens, but they do not agree with those of Francesch et al. (1998) or Cubiló and Tor (1999b). These authors indicate that, for native breeds, capons show a greater deposition of abdominal fat. This could be due to the interaction between genetics and nutrition.

Capons come to market with different weights depending on their genetic background and type of rearing. The weight of the present eviscerated carcasses is of the same order as those sold under the name «Caponcito de Villalba» (Anonymous, 1998) or «Petit Chapon de Loué» (Anonymous, 1999).

Caponization led to a significant improvement in some carcass variables expressed both in absolute (grams) and relative terms (percentages). The most interesting were those expressed in percentages since these show that the differences found were not simply due to the birds achieving greater weight but to intrinsic differences. Most noticeable is the greater percentage of breast possessed by capons. This is important since this is one of the most highly valued pieces of the chicken. The same has been reported by other authors (Francesch et al., 1998; Tor et al., 1999; Cubiló et al., 2000a). It may be that, through a lack of sex hormones, castration causes changes in metabolism that lead to earlier development of the breast in capons – similar to the growth pattern seen in hens (Muriel, 1998). The effect of castration on the breast, plus its effect on the wings, explains why the values recorded for the butchered portions are so high, as suggested by Francesch et al. (1998) and Tor et al. (1999).

The interest attached to the complete dissection of the thighs + drumsticks is that it provides an idea of the ratio between the weight of the edible products and the bones, which gives a good picture of carcass quality as a whole (Ricard, 1972). The significantly higher percentage of edible product on rooster thighs + drumsticks is probably due to the fact that the proportion of muscle, in both parts of the leg, was significantly lower in capons (Tor et al., 1999).

The absence of any effect of castration on the sensorial characteristics of the final meat has also been reported by Zanusso et al. (2001). This author used a panel of trained tasters who tried breast and thigh meat. However, Mast et al. (1981), who used a panel of 12 tasters who evaluated meat samples from the pectoralis major, pectoralis minor and biceps femoris, reported capon meat to be more tender – though differences were not always significant. Our survey of the consumers showed there to be great differences of opinion, meaning that consumers do not all evaluate products with the same characteristics in the same way.

Further studies are needed to confirm the results of this work, and it is our intention to complement them with a more detailed analysis of the final product in order to distinguish differences with respect to adipose tissue, muscular tissue and skin. This will allow us to establish whether fat is responsible for some of the differences found between capons and roosters.

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