Struggling Behavior in Shackled Male and Female Broiler Chickens

D. G. Satterlee,* 2 L. H. Parker,* S. A. Castille,* G. G. Cadd,* and R. B. Jones†

*Applied Animal Biotechnology Laboratories, Department of Poultry Science, Louisiana State University Agricultural Center, Baton Rouge, Louisiana 70803; and †Roslin Institute (Edinburgh), Welfare Biology Group, Roslin, Midlothian EH25 9PS, United Kingdom

ABSTRACT Anecdotal evidence suggests that the struggling behavior of shackled broiler chickens may be positively related to compression of the shank and the probable associated discomfort: birds with large shanks tend to struggle more violently than those with smaller shanks. Males are generally heavier and have thicker shanks than females. Therefore, we tested the hypothesis that, because the leg gaps of shackles are fixed in size, male broilers would struggle more than females. At 42 d of age, 264 floor-reared broilers were cooped in groups of 12 (six males and six females) and were transported from the university farm to the abattoir. Eighty of these served as test birds (n = 40/sex) and were shackled on a moving processing line with a bird of randomly selected sex on either side. Upon shackling, the latencies to struggle, numbers of struggling bouts, and total time spent struggling were recorded during a 1-min test period. Subsequently, the BW and circumference of the right shank (CRS) of each test bird were measured. Male birds were heavier and had thicker shanks than females (both P < 0.0001); they also struggled sooner (P < 0.01) and longer (P < 0.008). When data from males and females were pooled, CRS was negatively correlated with latency to struggle (r = −0.30; P < 0.006) and positively associated with SB (r = 0.23; P < 0.04) and total time spent struggling (r = 0.23; P < 0.04). However, there were no detectable correlations within sex. Body weight was not significantly correlated with any of the struggling behavior measures.

INTRODUCTION

Struggle (primarily wing flapping) of shackled birds typically occurs during ante- and postmortem conditions in the laboratory (Jones et al., 1998a; b) and at processing plants (Gregory and Bell, 1987; Sparrey and Kettlewell, 1994). Such wing flapping, which may be viewed as an index of discomfort (Sparrey and Kettlewell, 1994) can often be violent in nature. It is clearly important to limit this behavior in shackled fowl to reduce carcass downgrade and to maintain meat quality by reducing the incidences of bruises, red wing tips, and broken bones and by insuring greater muscle tenderness (see below). Reduction in struggling during the brief period immediately after live-bird hanging and before stunning (the antemortem period) may also reduce discomfort and, thereby, improve the well-being of the birds. Indeed, the

Royal Society for the Prevention of Cruelty to Animals (RSPCA) mandated (Anonymous, 1997) in their Welfare Standards for Chickens that “appropriate measures must be taken to prevent wing flapping during the processing of poultry.” The listed curative measures included “the use of a breast bar, curtains, reduction in noise, low-light intensity, and running one’s hands down birds at shackling.”

It has been estimated (Northcutt and Buhr, 1998) that nearly one in five downgraded broiler carcasses results from surface trauma that manifests itself in a bruise. Last year, in the US, bruising affected more than half a billion carcasses, and older, heavier birds showed the highest incidence of bruising leading to carcass downgrading. Bruises can occur anywhere from the grow-out house (e.g., during daily management activities, particularly during catching and feed withdrawal) to the processing plant (e.g., during unloading, stunning, hanging, and bleeding). However, a significant amount of bruising is also thought to occur during violent antemortem strug-
gling, i.e., the time between live-bird hanging and bleeding (Gregory and Bell, 1987; Northcutt and Buhr, 1998).

Struggling of shackled chickens and turkeys has been generally associated with the production of lower muscle pH, an early development of rigor mortis, and higher muscle shear values (Ma and Addis, 1973; Froning et al., 1978; Papinaho et al., 1995). Such findings are consistent with accelerated glycolysis, depletion of muscle ATP, and more rapid accumulation of lactic acid (Khan and Nakamura, 1970; Ma and Addis, 1973; Ngoka and Froning, 1982). Thus, any practical means of reducing struggling in shackled birds would likely prolong the onset of rigor with the attendant physiological changes (i.e., attenuated glycolysis, reduced muscle ATP degradation, and a higher final muscle pH from less lactic acid accumulation). These changes would, in turn, improve muscle tenderness.

Numerous factors present in commercial processing plants (e.g., rough shackling, plant noise, unevenness and bends in the conveyor line, temporary losses of visual contact between neighboring birds, and bright lights) have been qualitatively associated with the etiology of struggling behavior in shackled fowl (Gregory and Bell, 1987; Sparrey and Kettlewell, 1994). Wing flapping at the point of shackling has also been anecdotally associated with compression of the birds’ hocks because of tight-fitting shackles (Gregory and Bell, 1987). The latter observation notwithstanding, shackles with fixed-size apertures are widely used even though males are heavier and have thicker shanks than females (Yates et al., 1976; Satterlee and Gildersleeve, 1983). Therefore, the present study compared the struggling responses of shackled male and female broiler chickens.

**MATERIALS AND METHODS**

**Animals and Husbandry**

Three hundred mixed-sex Arbor Acres × Arbor Acres (AA × AA) broiler chicks (Day 1) were obtained from a commercial source. Chicks were reared to 42 d of age at the Louisiana State University Poultry Farm in an open-sided, fan-ventilated house. During grow-out, birds were maintained on deep litter (pine shavings) in six floor pens (50 birds/pen; stocking density of 0.08 m²/bird). Each pen measured 3 × 1.5 m (length × width). Chicks were brooded with overhead gas heaters set at 32 C at chick head height during the first week. Brood temperatures were adjusted to supply a weekly decline of 3 C until ambient temperature was achieved (21 C). Birds were fed a corn-soybean based starter ration (23% CP, 3,190 kcal ME/kg) from 1 to 14 d of age and then were switched to a grower ration (18% CP, 3,190 kcal ME/kg). Feed and water were supplied ad libitum. A 24-h photoperiod of dim light was provided throughout the grow-out period.

**Test Procedure**

At 42 d of age, feed was withdrawn from all birds at 0800 h. The birds were then randomly captured at 1200 h, sexed, and placed into 22 crates until each one contained 12 birds (six males and six females). Each coop (crate) contained only pen mates, and the male birds selected for testing were identified via a small spray paint mark on the backs of their necks. Immediately after being crated, the birds were transported in an open bed of a pick-up truck to the Louisiana State University Department of Poultry Science abattoir (travel time was approximately 30 min). Upon arrival at the abattoir, at approximately 1230 h, the birds were placed in a well-ventilated holding room, and they remained there until tested. The ambient temperature during the journey to the processing plant and within the holding area was approximately 21 C.

This arrangement provided 40 birds of each sex for testing at the abattoir. Specifically, 10 birds (five males and five females) from each of eight randomly selected crates of birds were used as test subjects. One hundred sixty of the birds from the remaining 14 crates were used as untested flankers, i.e., one bird of randomly selected gender was shackled on either side of the test bird. Tests began at 1400 h, and all birds were used once only. At test, one bird was removed from one crate while two others were caught from a separate crate. These birds were then carried in an upright position by three experimenters to the test room and were suspended by their legs from adjacent shackles of a moving processing line. The leg apertures were fixed at 1.1 cm along the whole 18 cm length of the shackle. Light intensity (250 to 300 lx) and ambient temperature (approximately 21 C) were similar in the holding and test rooms.

The 1-min observation period began as soon as the shackler removed his hands from the central (test) bird. Nearby silent and still observers recorded the following: the latency until the first struggle (in s), the accumulated time spent struggling (s), and the numbers of struggling bouts. Immediately after each test, the circumference of the bird’s right shank (CRS; cm) and its BW (g) were also recorded. The CRS was measured approximately 2.5 cm above the ankle (midway between the ankle and hock). Tests were completed by 1800 h.

**Statistical Analyses**

Sex effects on the behavioral and morphological measures were examined by ANOVA with a completely randomized design, considering the main effect of treatment (sex). Spearman’s rho correlation coefficients and their corresponding levels of significance (probability values) were also calculated across and within sexes for the inter-relationships between several of these measures (see Table 2). The numbers of birds that did or did not struggle were also compared within sex using the chi-squared test for equal proportions.

**RESULTS**

Male broilers struggled significantly sooner ($P < 0.01$) and longer ($P < 0.008$) than did females (Table 1). Body
TABLE 1. Body weights, shank circumferences, and the struggling responses of male and female broilers shackled in groups of three on a moving processing line (means ± SEM)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sex</th>
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<tbody>
<tr>
<td>BW, g</td>
<td>Male</td>
<td>1,915.2 (±26.0)</td>
<td>1,656.1 (±23.3)</td>
</tr>
<tr>
<td>CRS, cm</td>
<td>5.08 (±0.03)</td>
<td>4.64 (±0.04)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LTS, s</td>
<td>21.3 (±4.4)</td>
<td>37.7 (±4.4)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>TSS, s</td>
<td>4.2 (±0.7)</td>
<td>2.0 (±0.5)</td>
<td>&lt;0.008</td>
</tr>
<tr>
<td>SB, no.</td>
<td>0.8 (±0.1)</td>
<td>0.6 (±0.1)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

1Test subject was middle bird of each trio (three-bird group) examined.
2CRS = circumference of the right shank, LTS = latency to struggle, TSS = total time spent struggling, and SB = number of struggling bouts.

Table 1 shows the body weights, shank circumferences, and the struggling responses of male and female broilers shackled in groups of three on a moving processing line. The table includes the means ± SEM for BW, CRS, LTS, TSS, and SB for males and females. The results indicate that BW and CRS were also greater (P < 0.0001) in male than in female broilers (Table 1). Examination of the pooled responses of males and females revealed that CRS was significantly correlated with total time spent struggling, number of struggling bouts, and latency to struggle (Table 2). However, none of these associations attained significance within the two sexes. Although CRS and BW were positively correlated (r = 0.68; P < 0.001), BW was not significantly associated with any of the behavioral measures.

Whereas significantly more males struggled than did not (28 vs. 12, respectively; X^2 = 6.4, df = 1; P = 0.01) the numbers of strugglers and nonstrugglers were similar among females (19 vs. 21, respectively; X^2 = 0.1, df = 1; P = 0.75).

**DISCUSSION**

The present findings clearly demonstrate that struggling was more pronounced in males than in females when 42-day-old broilers were suspended in groups of three from shackles with fixed-leg apertures on a moving processing line. Specifically, the males struggled sooner and for over twice as long as the females. The males were also 260 g heavier and had significantly thicker shanks than females.

Shank circumference was negatively correlated with the latency to struggle and positively associated with the time spent struggling and the number of struggling bouts when data from males and females were pooled. Although the most likely, an explanation for the greater struggling shown by males than females based on increased leg deformation and discomfort because of their thicker shanks must remain tentative because pooling data from two different populations is likely to artificially inflate the correlation coefficients. Indeed, there were no detectable correlations between CRS and any of the behavioral measures within sexes. It might also be argued that our findings reflected sex differences in the incidence of leg problems, such as tibial dyschondroplasia or angular deformities, and hence in the pain induced by shackling rather than differences in CRS. However, there is no consensus of opinion that leg problems are more common in males than in females (C.C. Whitehead, personal communication), and a previous study revealed no clear correlations between leg abnormalities and struggling during shackle (Kannan et al., 1997). Comparison of struggling behavior, leg abnormalities, and carcass damage within sexes in birds categorized as thin- or thick-shanked may help to clarify this issue.

At the outset of this study, we had also regarded BW as a potentially influential variable with the forces of gravity pulling the heavier males deeper into the shackle. However, although BW and CRS were strongly and positively correlated, BW was not significantly associated with any of the behavioral measures.

We do not claim that the cessation of struggling indicates the absence of pain, discomfort, or fear. We merely suggest that the adoption of immobility by a shackled broiler represents the most adaptive behavioral strategy in the circumstances.

In conclusion, many factors present in commercial processing plants may contribute to the violent struggling behavior often shown during the antemortem period. The present study identified sex as an important variable. If the loose association between shank circumference and struggling is confirmed and other potentially influential variables are discounted, designing a shackle to better accommodate variation in shank diameter might benefit welfare and product quality.

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**REFERENCES**


