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Effects of catching and transportation versus pre-slaughter handling at the abattoir on the prevalence of wing fractures in broilers

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Abstract

Fractures occurring in conscious broiler chickens are painful and severely compromise animal welfare. The aim of this study was to investigate the effects of pre-slaughter handling procedures on the frequency of wing fractures. Wings were examined for fractures in 11,609 broilers, from 12 different flocks, slaughtered in two abattoirs: one using bi-phasic CO_2 stunning (CS); and one using electric water-bath stunning (ES). The same broilers were examined: i) in lairage, representing fractures attributed to catching and transportation; ii) after evacuation of transport containers and shackling (only ES); and iii) post-stunning. The mean frequencies of wing fractures were: in the lairage; 0.8% (CS 0.73%, ES 0.88%); after shackling prior to stunning; 2.90% (only ES); and after stunning; 2.35% (CS 1.80%, ES 2.90%). Regardless of stunning method, significantly more fractures occurred during pre-slaughter handling at the abattoirs than during catching/transportation. The difference in prevalence between CS and ES was not significant. All fractures observed in the ES occurred in conscious animals, whereas in the CS it was not possible to distinguish between fractures occurring in conscious or stunned broilers. From a welfare perspective, fractures occurring on-farm/transport result in prolonged suffering and are thus considered more serious in risk assessments of broiler welfare, even though more fractures occur at the abattoir. Monitoring of wing fractures at abattoirs should be included as an indicator of broiler welfare.

Keywords: *animal welfare, broiler, catching, pre-slaughter handling, transport, wing fractures*

Introduction

There is growing evidence that poultry experience pain (Gentle 1992; McGeown *et al* 1999; Gentle & Tilston 2000; Nasr *et al* 2012) and, therefore, the prevalence of, eg wing fractures in live broilers has important welfare implications. Fractures in general may be attributed to pre-slaughter handling on-farm, the transportation or handling at the abattoir (Stuart 1985; Bayliss & Hinton 1990; Kettlewell & Mitchell 1994; Elrom 2001; Nijdam *et al* 2006). Wing fractures are among the most common post mortem findings in broilers that are dead-on-arrival (DOA) at the slaughter plant (Bayliss 1986; Gregory & Austin 1992; Nijdam *et al* 2006), however, the pre-slaughter steps attributing to these fractures in live broilers have not been investigated. The aim of this study was to investigate the effects of pre-slaughter handling procedures on wing fractures in broilers before bleeding in two abattoirs; one using bi-phasic CO_2 stunning (CS), and one using electric water-bath stunning (ES). The specific objective was to quantify the number of live broilers with wing fractures: i) upon arrival at the abattoir, ie attributed to factors relating to catching and transportation (CS and ES); ii) after container evacuation and shackling (ES); and iii) after evacuation of the containers, shackling and stunning, ie attributed to factors at the abattoir (CS and ES).

Materials and methods

Flocks and abattoirs

Two abattoirs were included in the study and six flocks were observed at each abattoir. The 12 flocks were all Ross 308 hybrids, mixed gender, 31 days of age, which is the mean slaughter age for broilers in Norway. All broilers were manually caught. One abattoir used biphasic CO_2 stunning (CS); 40% CO_2 for 1 min, followed by 80% CO_2 for 2 min (Stork®, Linco, UK), the other used electrical water-bath stunning (ES); total current 4.1 A, 150 mA per bird, 300 Hz (Meyn®, Linco, UK). Both abattoirs used the same type of transport containers (Stork®, 2.43 × 1.30 m [length × height], eight drawers, minimum 200 cm^2 per kg live bird, ie more than the minimum required 160 cm^2 per kg). At the CS abattoir, broilers were emptied directly from the containers into the CO_2 tunnel, whereas live broilers were shackled prior to stunning at the ES abattoir. The broiler containers were emptied onto tilted slides at the CS from a maximum evacuation height of 50 cm. The ES abattoir did not have slides and the evacuation heights were 83, 65, 47 and 29 cm, respectively, for the four container compartments.

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Method of observation

Wing fractures were defined as open or closed fractures and detachment of epiphyseal plates with visible bleeding around the elbow joints. Dislocated wings and wings hanging straight down were also scored as broken wings (Grandin 2010). Three containers were arbitrarily selected from each of the six flocks in both abattoirs and a total of 11,069 birds were examined (range 860 to 997 per flock) for wing fractures in the lairage after careful removal from the containers. Birds with wing fractures were registered and immediately euthanised. Birds without fractures were carefully replaced in containers and forwarded to the slaughter line. In the CS abattoir, broilers were directly forwarded from the container evacuation and to the gas tunnel, making it impossible to examine broilers immediately after evacuation. A total of 5,612 broilers were examined on the slaughter-line in the CS abattoir. In the ES abattoir, a total of 5,348 birds were examined for wing fractures prior to stunning, ie after evacuation and shackling (range 848 to 950 per flock) and again after stunning. In the CS and ES abattoirs combined, a total of 10,960 birds were examined post-stunning, before decapitation and de-feathering (range 848 to 991 per flock).

Statistical analysis

Statistical analyses were performed using Stata version 12 SE (Stata Corp LP, TX, USA). The overall cut-off for statistical significance was $P < 0.05$. The Welch's unequal variances *t*-test was used to compare the following mean prevalence:

- Total wing fractures (ES and CS) in the lairage and after stunning;
- Wing fractures in the CS lairage and CS after stunning;
- Wing fractures in the ES lairage and ES after stunning;
- Wing fractures in the CS lairage and ES lairage; and
- Wing fractures after stunning in the CS and ES abattoirs.

The observations of wing fractures were performed by two observers. The rater reliability was tested by Cohen's kappa statistics, without comparison to a gold standard (post mortem examination).

Results

Wing fractures

The total mean prevalence of wing fractures in the study population was 0.80% (range 0.32 to 1.44% on flock level) in the lairage, and 2.35% (range 1.06 to 3.95% on flock level) after shackling. The difference in the total prevalence of wing fractures observed in lairage and on the slaughter-line was significant ($P < 0.01$). The mean prevalence of wing fractures was 0.73% (range 0.32 to 1.20) and 1.80% (range 1.06 to 2.98%) in the CS lairage and after shackling, respectively ($P = 0.01$). The mean prevalence of wing fractures was 0.88% (range 0.34 to 1.44%) and 2.90% (range 1.16 to 3.95%) in the ES lairage and after shackling, respectively ($P < 0.01$). The difference in mean prevalence between the two abattoirs in the lairage and after shackling were not statistically significant ($P = 0.5$ and $P = 0.06$, respectively). At the ES abattoir, wings were examined on the slaughter-line in two places (after shackling and after stunning) and the prevalence of fractures was equal at the two sites. In total, 18 broilers were dead-on-arrival and were not examined for wing fractures.

Inter-observer reliability

The inter-observer reliability test showed an agreement between the observers in the classification of wing fractures of 75% with a coefficient $\kappa = 0.73$ ($P < 0.01$). The results were not additionally confirmed by post mortem examination.

Discussion

The main findings of the current study suggests that wing fractures in live broilers are attributed to pre-slaughter procedures on-farm, during transport and handling at the abattoir, but that the majority of wing fractures occur at the abattoir. All broilers were caught manually, which has previously been identified as an important cause of wing trauma in broilers (Stuart 1985; Knowles & Broom 1990; Gregory & Austin 1992; Kettlewell & Mitchell 1994). Thus, although broilers were not examined for wing fractures on the farms prior to catching in this study, it is likely to assume that catching and loading may have contributed to the fractures observed upon arrival in the lairage (Grandin 2010).

Some fractures may have occurred during transportation; however, the current study could not differentiate these from fractures inflicted on the farm.

The result shows significantly more wing fractures attributable to pre-slaughter procedures at the abattoirs as compared to in lairage, equal to 1.55%. Although not significant, more wing fractures were found during pre-slaughter handling at the ES abattoir compared to the CS (1.10%). This difference may be attributable to the difference in container evacuation heights. It has previously been shown that 1.6% wing fractures may occur in broilers exposed to the same CO_2 regime as currently used (McKeegan *et al* 2007a). This is due to struggling, wing flapping and muscular spasms experienced during the last phase of the stunning in unconscious birds (McKeegan *et al* 2007b). Furthermore, it has been shown that bypassing the automated evacuation, a total of 1.2% wing fractures are attributed to CO_2 stunning alone (Abeyesinghe *et al* 2007) and not by container evacuation. These studies of CO_2 stunning indicate that most wing fractures occur in unconscious birds during stunning and not during the pre-slaughter procedures prior to this. In contrast to this, the current study shows that all fractures observed on the slaughter line at the ES abattoir were inflicted on conscious birds during container evacuation, prior to stunning.

Animal welfare implications and conclusion

This study shows that a significant proportion of wing fractures in broilers are attributed to pre-slaughter handling at the abattoir. An important finding is that these fractures are inflicted on conscious as well as unconscious broilers. However, it has to be emphasised that although there are

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significantly more wing fractures during pre-slaughter handling at the abattoir, fractures occurring during catching and transport are of particular importance, due to the time aspect of the suffering and handling practice upon arrival at the abattoir. In a practical setting, our results indicate that 3.11% of the study population would have been inflicted with wing fractures. Assuming that the study is representative for Norwegian broiler production, the prevalence of wing fractures in the total population of slaughtered broilers (n = 69 million) is approximately 2.15 million broilers annually. To improve welfare in commercial broiler production, it is necessary to perform large-scale epidemiological studies on the prevalence and risk factors associated with wing fractures to develop risk-based welfare-monitoring systems. Furthermore, training of staff involved in catching, transport and at the abattoir may reduce the frequency of wing fractures (Grandin 2010). Wing fractures caused by the feather-picking machines during de-feathering are not important from an animal welfare aspect and therefore the site of observations for future systems for risk-based monitoring requires careful consideration.

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