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Evaluating the Incidence of Gastrocnemius Tendon Rupture in Broiler Chickens

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Abstract: The effect of feeding 3-nitro-4-hydroxyphenylarsonic acid (3-nitro) in broiler diets during low (May) and high (July) temperature months on the incidence of gastrocnemius tendon rupture (GTR) was evaluated in this study. All observations were made at a single processing plant during the months of May and July, 2010. The average live body weight (BW) of birds processed in May and July were 3.8 and 3.6 kg, respectively. The birds processed in May were fed 3-nitro in starter and grower diets (22 g/ton), whereas birds processed in July were fed 3-nitro in grower (34 g/ton) and finisher (22 g/ton) diets. Affected gastrocnemius tendons were classified as fibrosed and trimmables tendons, with trimmables subdivided into acute or chronic tendons. Data analysis by Poisson regression showed higher incidences of acute and fibrosed tendons in the month of May when compared to the month of July. Although GTR can be caused by pathogenic and non-pathogenic factors, in this field study a higher incidence of GTR observed in birds reared during low temperature months may be associated with a heavier live BW of the birds and the introduction of 3-nitro early (starter diet) in the grow-out period.

Key words: 3-nitro-4-hydroxyphenylarsonic acid, broiler, tendon rupture, temperature

INTRODUCTION

Leg problems in broiler chickens account for 2.1% of annual losses due to condemnation and downgrading during processing, resulting in an estimated loss of $80-120 million (Morris, 1993). Rapid development and heavy Body Weight (BW) have been implicated in musculoskeletal disorders in broiler chickens. Rupture of the gastrocnemius tendon has been recognized as a major cause of lameness in poultry. Several causative factors have been attributed to rupture of the gastrocnemius tendon. These factors include pathogenic agents such as reovirus and staphylococcus *spp*, that cause viral and bacterial tenosynovitis, respectively (Hill *et al*., 1989) and non-pathogenic factors such as the use of dietary 3-nitro, season of the year, sex of the bird (Laster *et al*., 1999) and BW of the live bird (Morris, 1993; Sorensen *et al*., 1999).

Dietary 3-nitro can be used as a growth promotant in broilers to increase growth rate, improve feed efficiency (Waldroup *et al*., 1990) and the efficacy of anticoccidial drugs (Bufundo *et al*., 1989). However, it has been widely suggested that occasional side effects such as leg problems, associated with 3-nitro, can be exacerbated by environmental stressors such as heat (Waldroup *et al*., 1995). In response to reports indicating higher than expected leg condemnations in a commercial processing plant in Mississippi, this field study was conducted to evaluate the incidence of GTR in broiler chickens fed 3-nitro during low and high temperature months and processed in May and July, at a commercial processing plant.

MATERIALS AND METHODS

Broiler chickens were selected from commercial growers within a specific location in Mississippi and were monitored at a single processing plant for the duration of the study. The parameters considered in this study were: grow-out atmospheric temperature and Relative Humidity (RH), the company's grow-out program (3-nitro inclusion in diet) and the live BW of the birds at processing. Other contributing factors such as effects of house conditions (litter condition, temperature and humidity), lighting and vaccination programs were not considered in this study. Birds that were processed in May were fed starter and grower diets that contained 3-nitro during grow-out, whereas birds that were processed in July were fed grower and finisher diets that contained 3-nitro during grow out (Table 1). Hourly atmospheric temperature and RH readings for the grow-out periods of birds processed in May and July, 2010 were obtained from a local airport in Mississippi (Table 2). The atmospheric temperature and RH increased by 8.0°C and 7.6%, respectively, from May to July. The overall average live BW of birds processed in May and July were 3.8 and 3.6 kg, respectively (Table 3).

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Table 1: Grow-out program for birds processed in May and July, 2010[1,2]

Diet	Processing Month	Coccidiosis program	3-nitro (g/ton)	Antibiotics
Starter (1-14 days)	May	Nicarb	22	BMD 50
Grower (15-28 days)	May	Nicarb	22	BMD 50
Finisher 2 (29-49 days)	May	Deccox	0	Stafac 10
Finisher 3 (50 days Processing)	May	0	0	Stafac 10
Starter (1-14 days)	July	Vaccine	0	Stafac 20
Grower (15-28 days)	July	Vaccine	34	BMD 50
Finisher 2 (29-49 days)	July	Vaccine	22	BMD 25
Finisher 3 (50 days Processing)	July	Vaccine	0	BMD 25

[1]Birds were raised commercially for an average of 62.7 days and were processed in May, 2010
[2]Birds were raised commercially for an average of 63.3 days and were processed in July, 2010

Table 2: Grow-out atmospheric weather conditions for birds processed in May and July, 2010[1,2]

Week	Month	Average temperature (°C)	Average relative humidity (%)
1	May	16.8	64.5
2	May	17.7	64.2
3	May	18.6	65.4
4	May	20.1	66.4
1	July	25.7	72.6
2	July	26.3	72.6
3	July	26.5	72.7
4	July	26.7	73.1

[1]Average weekly atmospheric reading in which birds were commercially reared, grouped according to months in which birds were processed
[2]Hourly atmospheric readings were obtained from a local airport in South Mississippi

Table 3: Average weekly Body Weight (BW) of birds processed in May and July, 2010[1]

Week	Month	Age of birds (days)	Average BW (kg)
1	May	62.8	3.72
2	May	62.6	3.81
3	May	62.5	3.72
4	May	63.0	3.81
1	July	63.2	3.58
2	July	63.4	3.58
3	July	63.6	3.63
4	July	63.1	3.63

[1]Average weekly Body Weight of birds processed in May and July, obtained from the commercial processing plant

Table 4: Weekly data of number of ruptured tendon incidences in May, 2010[1]

Month	Week	Total No. observations	No. fibrosed tendons[1]	No. acute tendons[1]	No. chronic tendons[1]
May	1	7257	253 (3.5%)	66 (0.9%)	37 (0.5%)
May	2	8345	470 (5.6%)	108 (1.3%)	32 (0.4%)
May	3	8315	334 (4.0%)	52 (0.6%)	15 (0.2%)
May	4	8212	245 (3.0%)	57 (0.7%)	20 (0.2%)
Total	-	32,129	1302 (4.1%)	283 (0.9%)	104 (0.3%)
July	1	8240	141 (1.7%)	69 (0.8%)	50 (0.6%)
July	2	8261	186 (2.3%)	53 (0.6%)	19 (0.2%)
July	3	8333	267 (3.2%)	30 (0.4%)	20 (0.2%)
July	4	8028	438 (5.5%)	44 (0.6%)	30 (0.4%)
Total	-	32,862	1032 (3.1%)	196 (0.6%)	119 (0.4%)

[1]Percentages are given as a proportion of the number of incidences to the total number of observations on a weekly basis

The occurrence of GTR in processed broilers was assessed by visually counting and classifying a total of 64,991 broiler legs from 15 different farms during a total of 8 weeks for which the study was conducted (Table 4). All GTR counts were obtained by a single observer at a single processing plant. Evaluation of affected legs was based on the progression of the GTR syndrome and was categorized as normal, fibrosed, acute, or chronic (Fig. 1). The acute and chronic classified legs were combined to form a 'trimmables' group. Data were collected at the processing plant once a week (morning and evening shifts) for 4 weeks in each month of May and July. At each visit to the processing plant, observations were made in-line every 5 minutes, so that an average of 70 birds per minute or 350 birds every 5 minutes were evaluated. All GTR data were analyzed as acute, chronic or fibrosed. Data was analyzed by Poisson regression using a mixed model of SAS software 9.2 (SAS Institute, 2010). Farm within plant visit was included as a random effect. The relative risks of the occurrence of fibrosed, acute, chronic and trimmables legs in the month of May versus July were calculated. Statements of statistical significance were based on $p<0.05$ unless otherwise stated. The results in this study are presented as relative risks of GTR incidences in the month of May compared to the month of July.

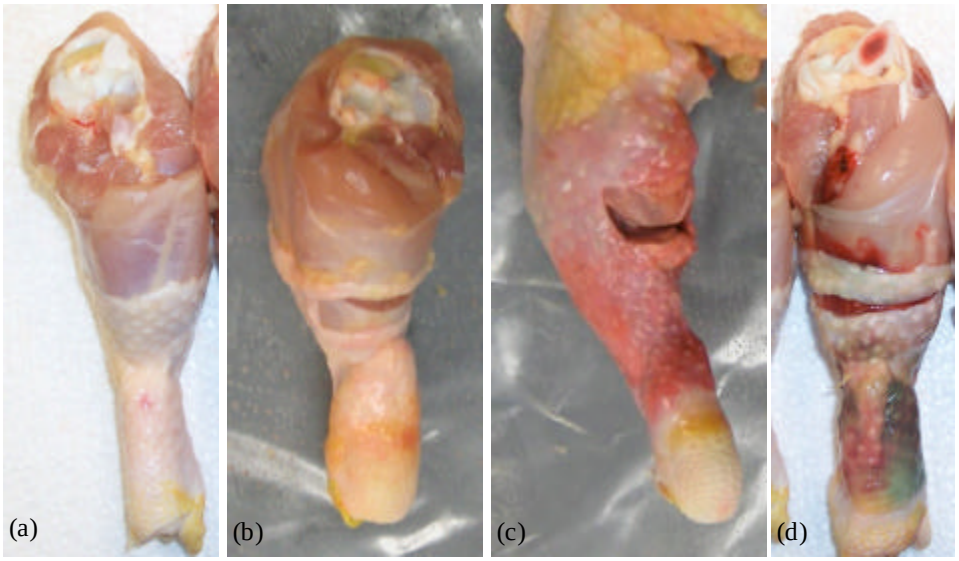

Fig. 1(a-d): Picture showing how the lesions were graded. Classifications of ruptured gastrocnemius tendons: (a) Normal (b) Fibrosed (c) Acute (d) Chronic

RESULTS AND DISCUSSION

The results obtained in this study showed that birds processed in May had a relative risk of 1.60 for acute GTR ($p<0.02$) and were more likely to be at risk for acute GTR than birds processed in July. There was no significant difference between both months for chronic GTR incidences ($p = 0.98$; relative risk = 1.01). The trimmables (acute and chronic) GTR incidences showed that birds harvested in May had a relative risk of 1.37 ($p<0.12$) and were more likely to be at risk for GTR than birds processed in July. Similarly, birds processed in May had a relative risk of 1.42 ($p<0.10$) for fibrosed incidences and were more likely to be at risk for fibrosed GTR than birds processed in July. In this study, suggestive causes of GTR were based on the evaluation of grow out programs, grow-out atmospheric conditions and the live BW of birds at processing. The records of breeder flock reovirus vaccination and broiler staphylococcus infections were not investigated in this study since there were no reported cases or complaints noted on the evaluated farms.

The progression of GTR syndrome can be explained as the occurrence of a fibrosed tendon that eventually culminates into a ruptured tendon, so that the fibroses may be the cause of the tendon rupture rather than a response to it. The heavy mature fibroses (Fig. 1b) breaks during the birds' physical activities progress into an acute or chronic GTR depending on the time the tendon rupture occurs. Acute tendon rupture occurs less than 48 hours before processing and is characterized by wide spread hemorrhage (Fig. 1c), while chronic tendon rupture occurs more than 48 hours before processing and is characterized by deteriorated blood vessels and older hemorrhage producing a green coloration (Fig. 1d). The heavier BW of birds that were processed in May compared to July (Table 3) may have contributed to a higher incidence of acute GTR observed in the month of May. It has been suggested that the incidence of GTR is greater in heavier birds when compared to light BW birds. GTR are mostly seen in older broilers and are associated with a heavy BW and poor tendon development (Riddell, 1992). Rapid growth of birds may cause poor blood supply and poor tendon strength, as a result, the gastrocnemius tendon separates by pulling apart above the hocks, causing lameness in affected birds (Julian, 1998). Another factor that may play a role in increased incidences of GTR in birds processed in May, is the introduction of 3-nitro in feed early in the grow-out period. The 3-nitro was added in starter and grower feed in May, but was added in grower and finisher diets in July. Fast-growing meat birds such as broiler chickens can exhibit leg problems as early as 10 to 14 d of age but more usually are seen at 21 to 35 d of age (Riddell, 1992). Therefore, feeding 3-nitro early in the broiler chicken's life may favor the development of leg problems.

Although it has been suggested that the addition of 3-nitro in broiler diets, especially during heat stress, increases the incidence of GTR, our findings suggest that GTR incidences can also increase during cooler months. This strongly suggests that although 3-nitro may play a role, an interplay with other non-infectious factors is an important consideration in determining the cause of GTR.

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