Brazilian Journal of Poultry Science
Revista Brasileira de Ciência Avícola

ISSN 1516-635X Jul - Sep 2009 / v.11 / n.3 / 149 - 154

Field Evaluation of Broiler Gait Score Using Different Sampling Methods

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■ Keywords

Animal welfare, environmental rearing conditions, locomotion deficiency.

ABSTRACT

Brazil is today the world's largest broiler meat exporter; however, in order to keep this position, it must comply with welfare regulations while maintaining low production costs. Locomotion problems restrain bird movements, limiting their access to drinking and feeding equipment, and therefore their survival and productivity. The objective of this study was to evaluate locomotion deficiency in broiler chickens reared under stressful temperature conditions using three different sampling methods of birds from three different ages. The experiment consisted in determining the gait score of 28, 35, 42 and 49-day-old broilers using three different known gait scoring methods: M1, birds were randomly selected, enclosed in a circle, and then stimulated to walk out of the circle; M2, ten birds were randomly selected and gait scored; and M3, birds were randomly selected, enclosed in a circle, and then observed while walking away from the circle without stimulus to walking. Environmental temperature, relative humidity, and light intensity inside the poultry houses were recorded. No evidence of interaction between scoring method and age was found however, both method and age influenced gait score. Gait score was found to be lower at 28 days of age. The evaluation using the ten randomly selected birds within the house was the method that presented the less reliable results. Gait score results when birds were stimulated to walk were lower than when they were not simulated, independently of age. The gait scores obtained with the three tested methods and ages were higher than those considered acceptable. The highest frequency of normal gait score (0) represented 50% of the flock. These results may be related to heat stress during rearing. Average gait score incresead with average ambient temperature, relative humidity, and light intensity. The evaluation of gait score to detect locomotion problems of broilers under rearing conditions seems subjective and difficult to be properly performed.

INTRODUCTION

Lame broilers cannot walk freely and are not able to reach either the feeder or the drinker when hungry or thirsty, limiting their survival and productivity. The gait score system is an estimation of locomotion deficiency and it is based on the visual judgment of the ability a broiler chicken has to walk on a known surface. The rearing environment is considered to be one of the main aspects related either to the success or failure of broiler production. According to Knowles *et al*. (2008) modern management techniques associated to the genetic characteristics of rapidly-growing broilers have compromised their welfare, as well as their walking ability. Bessei (2006) points out that the light intensity control plays an important role in bird moving capacity inside the housing, and light intensities beyond the limits of 6 to 10 lx may directly influence

Arrived: March/2009
Approved: August/2009

the incidence of locomotion abnormalities. Literature studies report that broiler chicken lameness problems are related to genetic strains (Bokkers & Koene, 2004; Bizeray *et al*., 2000), to bird age, and to flock density (Sorensen *et al*., 2000), in addition to high weight gain rate (Bizeray *et al*., 2000).

The gait score system developed by Kestin *et al*. (1992) has been used to assess lameness in broilers, and the methodology consists of empirical repetitive visual observations of how birds walk on a surface. The system is divided into six levels of observed leg weakness, as follows: 0 (sound bird); 1 (the bird moves fast, but a slight walking deficiency is observed); 2 (the bird moves fast, but there is significant walking deficiency); 3 (the bird moves fast, but it presents an important deficiency); 4 (the bird moves with serious difficulty); and 5 (the bird barely moves and often uses the wings for crawling).

Garner *et al*. (2002) modified the previous system, simplifying the rules by removing the intermediate scores as they are difficult to estimate. The new system uses four levels of walking ability: 0 (sound bird that walks ten steps normally); 1 (average bird that walks ten steps with some degree of difficulty and presents some unbalance during walking); and 2 (lame bird that walks with great difficulty and sits after 1 to 4 steps) (Dawkins *et al*., 2004). This is also an individual and subjective evaluation, and therefore it is difficult to compare these two systems as well as the scores given by two different observers.

Grandin (2007) recommends that, in commercial farms, gait score is assessed by randomly selecting around 100 broilers in two different areas of the house, and trying to observe the birds while they move away from that specific place towards other areas. High welfare standard is when 95% - 99% of the broilers present gait score below 1, and welfare is considered acceptable when 70% of the birds walk soundly. Dawkins *et al*. (2004) suggest that one single bird, randomly chosen in the house, needs to be observed and analyzed in ten distinct places.

This study aimed at evaluating lameness in broiler chickens reared in poultry houses, with open sides and natural ventilation and limited environmental control resources, using a simplified system of gait scoring. An association among welfare, observed lameness, and three sampling of gait score evaluation system were studied.

MATERIALS AND METHODS

The experiment was carried out from September to November 2008, in three commercial integrated broiler chicken farms located in the counties of Itatiba and Louveira, in the state of São Paulo, Brazil. The climate of the region is type Cwa, according to Köeppen classification. Average regional temperature varied between 18 and 31°C.

Visual observation of the gait score was carried out with 28, 35, and 42-day-old broilers randomly selected from the flocks of the selected houses. Gait score was estimated using a three-scale scoring system (Dawkins *et al*., 2004), by a skilled observer.

Bird sampling method

Three different sampling methods were used to assess gait score:

- Method 1 (M1) - With walking stimulus: A circle was built using 2-mm thick plywood boards (the same used for building the brooding circles), enclosing 100 randomly-selected birds. Broilers were stimulated to walk away from the circle by a person walking slowly behind them. Half of the total numbers of birds (50%) were gait scored.
- Method 2 (M2) - Ten birds were randomly selected in different areas inside the house, and were gait scored using the system proposed by Dawkins *et al*. (2004).
- Method 3 (M3) - No walking stimulus: One hundred randomly-selected birds were enclosed inside the house, and they were gait the previously described circle, and were allowed to walk freely outside the circle. Half of the birds (50%) were gait scored (Grandin, 2007).

Environmental parameters

The following broiler house environmental parameters were measured during the tests: dry bulb temperature (T, °C), air relative humidity (RH, %) and air velocity (AV, m s^{-1}) using the thermal hydro-anemometer HTA®; light intensity (L, lx), using a digital luximeter ISBB®260; and ammonia concentration (A, ppm) using the manual pump Accuro Dräger® and respective reagents. The parameters were recorded at three different points: geometric center, and both ends of the houses. At each location three measurements were made in the morning, starting at 10:00 AM, and three in the afternoon, starting at 03:00 PM, with an interval of 15 to 20 min between each measurement.

Data analysis

The collected data were submitted to analysis of variance at 95% significance level. Correlations between environmental parameters and gait score were tested using Pearson's linear correlation.

The hypothetical broiler welfare distribution was determined based on Grandin's (2007) concept, which establishes that welfare standard is high when 95 to 99% of all observed broilers present gait scores between 0 and 1 in the six-level scale. Assuming that gait scores 0 and 1 in the six-level scale correspond to the gait score 0 in the three-scale system, it was estimated that the welfare standard was high when 95% of the birds present gait score 0. The remaining 5% would be distributed between gait scores 1 and 2. The Chi Square test was used to estimate welfare, and the observed gait score distribution was compared to the hypothetical distribution.

RESULTS AND DISCUSSION

Table 1 shows the ANOVA results of the effects of the factors Method and Age on gait score; in this case M1, M2, and M3 were taken into account. It was not possible to test the full interaction as M2 was only evaluated in 35 and 42-day-old birds. However, the available data showed significant influence of sampling method (Method) and Age on gait score results ($p < 0.05$).

Table 1. ANOVA results of the effects of sampling *Method* and **Age** on gait score.

Source of variation	Degree of freedom	Sum of Squares	Mean Square	F	P value
Method	2	4.0842	2.0998	4.55	0.011
Age	2	6.0676	3.0338	6.58	0.002
Error	315	145.2358	0.4611		
Total	319	155.3875			

M2 was removed from the analysis in order to test the interaction between factors. The factor *Method* (M1 and M3) significantly influenced gait score results ($p < 0.05$, Table 2).

Table 2. ANOVA results of the effect of sampling *Method*, *Age*, and *Method* and *Age* interaction on gait score.

Source of variation	Degree of freedom	Sum of Squares	Mean Square	F	P value
Method	1	4.0833	4.0833	9.06	0.003
Age	2	6.1067	3.0533	6.78	0.001
*Method * Age*	2	0.1867	0.0933	0.21	0.813
Error	315	132.4600	0.4505		
Total	319	142.8367			

No evidence of interaction between the factors of *Method* and *Age* was found. This showed that sampling *Method* influenced gait score independently from *Age*, and likewise, *Age* influenced gait score independently of the process used for sampling the birds. This means that both how birds are chosen and timing of gait score evaluation in the farm may affect the results obtained.

Figure 1 shows the confidence interval of mean gait score as a function of the sampling *Method*. It is observed that M2 has a high standard error around the mean, thereby indicating lower reliability of the results. In Figure 2, it is observed that M2 results behaved differently from the other methods (M1 and M3), also indicating that this sampling methods is not as reliable as the other two. The standard error of the mean value in M1 and M3 were relatively lower than M2, showing that the results obtained using methods 1 and 3 to sample birds are more reliable and accurate.

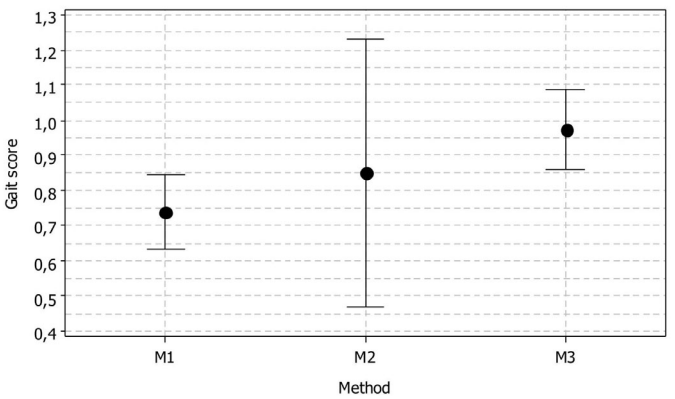

Figure 1. Interval plot graph showing the influence of sampling *Method* on gait score results.

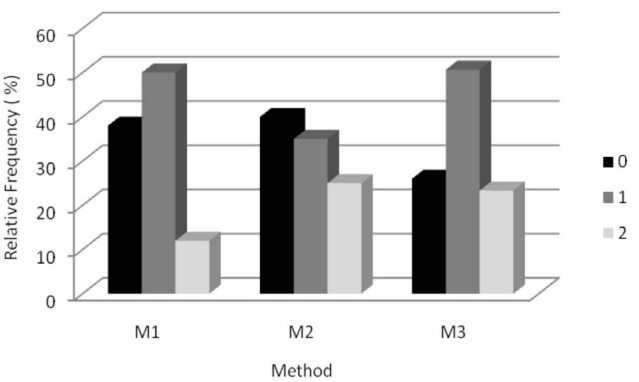

Figure 2. Distribution of the three levels of gait score according to the three methods used for bird sampling.

Figure 3 shows that, independently from sampling method, gait score was low at 28 days of age, increased at 35 days of age, and decreased at 42 days

of age. These results are partially consistent with the findings of Sorensen *et al*. (2000) who observed that limb disorders are a relatively reduced problem in young broilers. When using M1 gait score results, there was less lameness that when M3 was used, probably due to fact that the birds walk more than when using M3. Bokkers *et al*. (2006) found that broilers can be motivated to walk long distances to reach feed. According to Bizeray *et al*. (2000), locomotion activities in broilers during the last week of life may increase if birds are stimulated to move during the first days of life, contributing to reduce lameness.

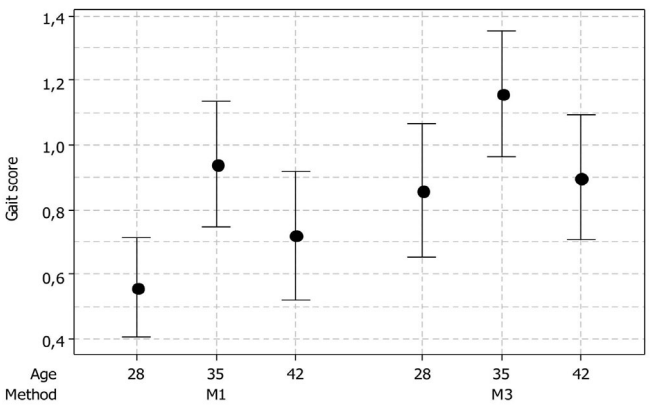

Figure 3. Interval plot showing the influence of age within two sampling methods on field gait score.

During the field experiment it was observed that, without the stimulus to induce birds to walk they barely gave a few steps and then rested influencing final gait score results. When stimulated they walked more and gait score results were better. Broilers do not walk often inside the poultry house, making it difficult to evaluated final gait score. It is not clear if not walking is related to pain or simply to the low frequency of this activity. On the other hand, when stimulated to walk, broilers make an extra effort to move, and move either faster or more than they usually do, which may interfere in the interpretation of the final gait score results. Weeks *et al*. (2000) found that sound birds spent 76% of their time lying, whereas lame birds spent 86%. The authors observed that lying behavior also increased with age. Similar results were obtained by Webster *et al*. (2008). In the present experiment, it was observed that some broilers reached the feeder or the drinker after few steps, or stopped walking when meeting another bird in their way. These birds received gait score 2; however, it cannot be stated that this meant they presented a locomotory problem.

As it cannot be ascertained that any specific bird was already tired of walking before the evaluation started, some degree of error may have been introduced in the gait score evaluation when M2 was used, as when birds are randomly selected, it is not known whether they are already tired or not, which may influence their walking behavior independently from its locomotory soundness. According to Webster *et al*. (2008) broilers may ignore some degree of pain either when facing something new or experimenting fear, which may also interfere in the final results. When M1 method was used 2% of the birds presented gait score 2 at 28 days of age, while this proportion was 20% when using M3 sampling (Table 3). Sorensen *et al*. (2000) found that less that 1% of 28-day-old broilers presented gait score 4 or 5. These results are higher than those obtained in the present experiment considering that gait score values of 4 and 5 correspond to score 2 in the three-points gait score scale.

Using M1 in a field study that applied the six-point gait score scale, Sanotra *et al*. (2001) and Kestin *et al*. (1992) found that 25% and 10% of birds of all ages presented gait score 0, respectively, while Brickett *et al*. (2007) found 62.5%. Although in the present study gait score was evaluated using the three-point gait score scale, gait score 0 results were higher than those found by Sanotra *et al*. (2001) and Kestin *et al*. (1992), and lower than those of Brickett *et al*. (2007), which results were higher than those obtained in the present experiment, independently from age or sampling method. Using the three-point broiler gait score scale in field, Dawkins *et al*. (2004) found that 61.1 to 80.8% of the birds presented gait score 0, which is also higher than those obtained in the present study (Table 3).

Table 3. Distribution of the frequency of gait score by age, using the three *Methods* (M1, M2, and M3).

Gait Score	M1			M2			M3		
	42	35	28	42	35	28	42	35	28
0	0.42	0.26	0.46	0.50	0.30	-	0.28	0.16	0.34
1	0.44	0.54	0.52	0.20	0.50	-	0.54	0.52	0.46
2	0.14	0.20	0.02	0.30	0.20	-	0.18	0.32	0.20

Using Grandin's (2007) hypothetical gait score distribution as related to broiler welfare, a statistical test was performed to compare the frequency distribution of estimated *versus* observed gait score. The results suggest that locomotory problems indicate a lack of welfare in the evaluated flocks (Tables 4 and 5, and Figure 3). The probable cause of these results is the harsh environmental rearing conditions (Table 5). For the three gait score evaluations carried out in this

Table 4. Chi-square statistical test for adjusting frequency distribution.

Gait score	Number of Observed Gait score	Proportion	Number of Estimated Gait score	Proportion	N	DF	÷2	P value
0	104	0.950	304	131.58	320	2	3256.58	0.000
1	158	0.025	8	2812.50				
2	58	0.025	8	312.50				

Table 5. Mean and standard deviation of recorded environmental parameter according to age at gait score evaluation.

Age (days)	A (ppm)		T(°C)		RH (%)		AV (m/s)		LI (lx)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
28	-	-	28.9	0.97	49.4	2.92	0.83	0.64	188.3	73.07
35	11.0	1.87	31.0	1.00	60.2	4.45	1.76	0.62	331.5	159.06
42	11.0	2.85	26.8	2.28	67.2	6.21	0.45	0.45	205.3	205.19

experiment, gait score increased as average environmental temperature, relative humidity, air speed, and light intensity increased. The only exceptions were the relative humidity values when the M2 sampling method was applied (Table 6).

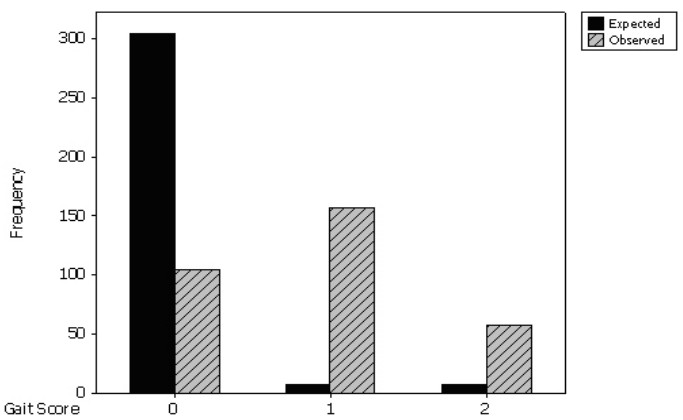

Figure 4. Comparative distribution of observed and estimated gait score and flock welfare condition.

Table 6. Correlation between environmental parameters and mean gait score values according to sampling method.

Ambient varibales	M1	M2	M3
RH (%)	0.53	-1.00	0.24
AV (m/s)	0.75	1.00	0.92
L (lx)	0.95	1.00	1.00
T (°C)	0.53	1.00	0.81

According to Dawkins *et al*. (2003), the percentage of broilers presenting poor performance during growth is positively correlated both with high environmental temperature and relative humidity, particularly between three and five weeks of age. The number of sound broilers (gait score=0) was negatively correlated with the time in which both environmental temperature and relative humidity departed from the recommended values. It is reported in literature that locomotory problems are related to harsh rearing environments. Bruno *et al*. (2007) found that broilers reared under heat stress presented reduced length and width of the tibia, femur and humerus. Light exposure is also another variable that is reported to influence broiler gait score results. Lin *et al*. (2006) determined that broiler locomotion may be affected when light management is beyond a 6 - 10 lx range. Bird performance is usually affected by the simultaneous occurrence of extreme values in factors related to the thermal and aerial broiler rearing environment (Martrenchar *et al*., 1997; Dawkins, 2003; Moura *et al*., 2006; Bessei, 2006).

CONCLUSIONS

It is difficult to estimate broiler gait score under field conditions as all evaluation methods are subjective. When comparing three distinct sampling methods, the use of ten broilers randomly chosen inside the house was shown to be the least reliable method.

The method adopted to estimate gait score influenced the final results.

High gait score values were related to the harsh environmental conditions recorded inside the broiler house.

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