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Short Communication

Locomotion problems of broiler chickens and its relationship with the gait score[1]

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ABSTRACT - The objective of this study was to evaluate the correlation between the ability to walk (gait score), incidence of femoral degeneration, tibial dyschondroplasia, valgus and varus deformity and leg symmetry of broiler chickens. Male chickens of the Cobb strain from a commercial poultry farm were utilized in this experiment. Fifty 35 and 42-day-old birds were evaluated according to the gait score and valgus or varus incidence. To assess the bilateral symmetry and the lesion score for femoral degeneration and tibial dyschondroplasia, broilers were weighed and euthanized for the removal of the femur and tibia of both legs. The lesion scores for femoral degeneration and tibial dyschondroplasia, varus or valgus deformity, bone symmetry and gait scores of the chickens were then correlated. It was found that weight, age and the incidence of femoral degeneration and tibial dyschondroplasia are not always correlated with the gait score and that only valgus deformity is more correlated.

Key Words: animal welfare, bone symmetry, femoral degeneration, tibial dyschondroplasia

Introduction

The prevalence of locomotion problems in broiler chickens of rapid growth has become a major concern in the poultry market, especially the export market, not only due to the poor performance of birds and slaughterhouse losses, but also to the detriment of animal welfare (Almeida Paz et al., 2010).

There are many ways to assess locomotion problems in broilers. The most common methods used are to visually inspect the locomotor ability of birds, called gait score (developed by the University of Bristol, England), and also the macroscopic evaluation of the region affected, which involves sacrificing the bird and section or displacement of the bone.

For tibial dyschondroplasia, the macroscopic examination assesses the accumulation and thickening of cartilage in the region of the epiphyseal growth plate. This is the condition in which a poorly vascularized cartilage mass, causing the region to be demineralized, extends distally from the growth plaque in the proximal epiphysis of the tibia (Tselepis et al., 1996). As for the femoral degeneration, the macroscopic examination is based on the integrity of the articular cartilage of the proximal femoral epiphysis.

Notwithstanding the measurement technique used, the scores assigned to bone integrity are always considered. Many researchers (Kestin et al., 1992; Garner et al., 2002; Almeida Paz, 2008) have developed techniques and scores to evaluate locomotion problems. For the most part, these scores vary between zero and five points. However, the trend is that the scores be reduced to only three grades, due to the difficulty of setting the limits between the intermediate scores (Almeida Paz, 2008). Therefore, many studies currently use scores arranged as follows: a score zero corresponds to a healthy bird; score 1 corresponds to a bird with an intermediate lesion; and score 2 corresponds to a bird with a serious lesion or locomotor disability.

The gait scoring system has been widely used to evaluate leg problems, but this methodology consists of the empirical visual observation of the locomotion factors (Nääs et al., 2010), and does not show bone or musculoskeletal problems that affect the birds, consequently causing

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walking difficulties. Therefore, the objective was to assess correlations between the gait score and locomotion problems, femoral degeneration, tibial dyschondroplasia, joint (valgus and varus) deviations and the symmetry of the legs of broilers at 35 and 42 days of age.

Material and Methods

Male broiler chickens (Cobb strain) were from a commercial poultry aviary, reared in a population density of 10 birds/m^2.

At 35 and 42 days of age, 50 birds in the poultry production were weighed individually and assessed by the gait score (GS) and valgus or varus deformities. Next, broilers were transported, in appropriate boxes, to an experimental slaughterhouse, where they were stunned by electronarcosis and slaughtered by cutting the jugular vein and carotid artery. After slaughter, the right and left legs of the birds were removed for bilateral symmetry evaluation and lesion scores by femoral degeneration and tibial dyschondroplasia.

The GS evaluation is a subjective measure of the ability of the bird to walk 1 m distance on a surface. For this assessment a score scale of 0 to 2 was used, as described by Almeida Paz (2008). A healthy bird, score 0, should walk normally without limping and take at least 10 steps in this distance; a score 1-bird walks with some difficulty and takes between 6 and 10 uninterrupted steps; a score 2-bird walks with much difficulty and takes less than 6 continuous steps within the one-meter distance.

The evaluation of valgus and varus was performed immediately after the GS evaluation, measuring the angle of the leg joints. A caliper and a protractor were used to measure the angle between the femur and the third finger in the left and right legs. When the angle was negative, it characterized varus deformity and when the angle was positive, it characterized valgus deformity (Almeida Paz et al., 2010).

The tibia and femur bones removed from both legs of the birds were dissected and then measured using a caliper to verify the bilateral symmetry; they were then evaluated for femoral degeneration and tibial dyschondroplasia macroscopic scores.

For femoral degeneration, the proximal femoral epiphysis of each leg was examined, assigning scores that ranged between 0 and 2, as described by Almeida Paz (2008): score 0 was equivalent to one part without lesion; score 1 was equivalent to a part with early lesion, which shows that the articular cartilage is not coating the bone (which may or may not be found in the acetabulum); and score 2 was equivalent to a part with a serious lesion, where the apparent contour of the femoral head no longer exists.

For the tibial dyschondroplasia examination, the growth plate cartilage thickness of the tibias was evaluated, receiving scores 0, in which there is no growth cartilage thickening; 1, with cartilage thickness varying between 1 and 3 mm; and score 2, related to thickness greater than 3 mm (Almeida Paz, 2008).

The statistical analysis of the results was performed by the analysis of variance (ANOVA), using the software Statistical Analysis System (version 8.2) and the GLM (General Linear Models) procedure. The means of live weight, femur length, tibia and valgus deformity were compared by Tukey's test ($P<0.05$). The frequency of locomotion problems were analyzed by the χ^2 test and the correlations were obtained by Pearson's test ($P<0.05$ and $P<0.01$).

Results and Discussion

There was no statistical difference between weight and the different gait score (GS) levels for each age evaluated (Table 1). The frequency of birds in each GS level was also not significantly influenced ($P<0.05$) by the different ages (Table 2).

Contrarily to the results obtained in this study, Nääs et al. (2010) found that the gait score increased according to the weight and age of the broilers, i.e., locomotion disability was more severe in older and heavier birds. Sorensen et al. (2000) also found a difference in the rate of birds evaluated with walking difficulties and the different ages (28, 42 and 49 days of age).

Table 1 - Mean weights (g) related to gait scores of broilers at 35 and 42 days old

Gait score	Age (days)	
	35	42
0	2039.23	2451.31
1	2153.23	2502.51
2	2132.10	2622.20
Mean	2091.44b	2473.16a
CV (%)	7.71	

CV - coefficient of variation.
Means followed by different letters in the same row indicate significant difference ($P<0.05$) by Tukey's test.

Table 2 - Broiler frequency according to gait score and age

Gait score	Age (days)	
	35	42
0	28a	31a
1	23a	18a
2	1b	1b

Means followed by different letters in the same column indicate significant difference ($P<0.05$) by the χ^2 test.

However, there was a difference (P<0.05) in the frequency of birds within the different GS, within the same age group (Table 2). The highest number of birds showed GS 0 and 1, both for 35 and 42 days of age. Therefore, most birds did not show a great degree of locomotion difficulties.

Varus deformity was not detected, but there were significant differences (P<0.01) for valgus deformity only in the left leg with regard to age, with the biggest difference found at 42 days (Table 3). For the different GS levels, some difference (P<0.01) was found in the right and left leg, with the largest articulation deviation related to GS 2 (bird with walking difficulty), indicating that this deformity may be related to these characteristics (GS and age). Sanotra et al. (2001), in a similar study, also found a positive correlation between GS and valgus deformity.

Concerning GS and the locomotion problems for femoral degeneration and tibial dyschondroplasia, it is observed that for GS 0 (bird that walks normally), the incidence of birds with 0 score for femoral degeneration and tibial dyschondroplasia (healthy birds) was significantly higher at 35 and 42 days of age (Table 4). However, this did not occur for GS 1 and 2, in other words, a bird that has difficulty walking does not always have the highest femoral degeneration or tibial dyschondroplasia score (serious lesion). These data indicate that there is not always a good correlation between these measures.

Weeks et al. (2000) and Garner et al. (2002) report that the GS assessment methodology, developed by Kestin et al. (1992) and adapted by Almeida Paz (2008), is an empirical methodology and therefore inaccurate. This can be confirmed in this study, in which the incidence of locomotion problems was not always different in normal walking broilers (GS 0) or birds with irregular walk (GS 1 and 2).

There were significant differences for the lengths of the right and left femur and tibia among the different ages (Table 5). This result was expected, once birds are in a growth phase. Bruno et al. (2007) also found that the

Table 3 - Mean values of valgus deformity (levels) with regards to the gait score found in broilers at 35 and 42 days old

Gait score	Right leg valgus			Left leg valgus		
	Age (days)			Age (days)		
	35	42	Mean	35	42	Mean
0	1.32	1.16	1.24c	1.02	2.42	1.72b
1	2.72	2.22	2.47b	3.23	3.33	3.28a
2	5.12	4.37	4.74a	4.57	3.84	4.21a
Mean	3.05	2.58		2.94B	3.20A	
CV (%)	80.99			59.05		

CV - coefficient of variation.
Means followed by different uppercase letters in the row and different lowercase letters in the column indicate significant difference (P<0.05) by Tukey's test.

Table 4 - Frequency of broilers with femoral degeneration and tibial dyschondroplasia according to gait score at 35 and 42 days of age

Gait score	Femoral degeneration scores											
	35 days of age						42 days of age					
	Right leg			Left leg			Right leg			Left leg		
	0	1	2	0	1	2	0	1	2	0	1	2
0	20aA	7aB	0aB	18aA	8aAB	1aB	17a	11a	3a	18aA	10aAB	3aB
1	14aA	7aAB	1aB	12a	9a	1a	8a	6ab	4a	10a	6ab	2a
2	0b	1a	0a	0b	1a	0a	0b	1b	0a	0b	1b	0a
	Tibial dyschondroplasia scores											
0	24aA	0aB	2aB	24aA	0aB	2aB	29aA	0aB	2aB	29aA	0aB	2aB
1	18aA	0aB	5aB	18aA	1aB	4aB	13bA	1aB	4aAB	13bA	0aB	5aAB
2	1b	0a	0a	1b	0a	0a	1c	0a	0a	1c	0a	0a

Means followed by different uppercase letters in the row and different lowercase letters in the column indicate significant difference (P<0.05) by the χ^2 test.

Table 5 - Mean femur and tibia length values (cm) with regard to the gait score found in broilers at 35 and 42 days of age

Gait score	Femur length				Tibia length			
	Right leg		Left leg		Right leg		Left leg	
	Age (days)		Age (days)		Age (days)		Age (days)	
	35	42	35	42	35	42	35	42
0	6.80	7.29	6.73	7.21	9.82	10.37	9.77	10.50
1	6.91	7.22	6.86	7.25	9.93	10.61	9.78	10.47
2	7.00	6.50	7.00	6.50	10.50	10.50	10.00	10.50
Mean	6.86b	7.25a	6.80b	7.21a	9.88b	10.46a	9.87b	10.49a
CV (%)	5.05		5.33		4.49		4.39	

Means followed by different letters in the same row indicate significant difference (P<0.05) by Tukey's test; CV - coefficient of variation.

femur and tibia length is pronounced up to 42 days of age. However, within the different GS, no significant difference was found for the lengths, i.e., the bones were symmetrical and therefore did not affect the walking ability of birds.

At 35 days, there was a moderate correlation (P<0.01) between GS and valgus deformity in both the right and left legs (Table 6), confirming the previous results found in this study. There was also a moderate correlation for femoral degeneration and a strong tibial dyschondroplasia correlation for both legs; both at 35 and 42 days of age (Table 6 and 7).

These results can be justified by the suggestion of Kealy (1987), who reported that femoral degeneration occurs in young animals, with no defined etiology, and may be unilateral or bilateral.

Moderate correlation (P<0.01) between the femur and tibia lengths of the right and left legs was observed, indicating symmetry for both ages.

Table 6 - Correlations between locomotion characteristics of broilers at 35 days of age

	Weight	GS	FDR	FDL	TDR	TDL	LFR	LFL	LTR	LTL	VR	VL
Weight												
GS	0.33*											
FDR	-0.07	0.20										
FDL	-0.06	0.15	0.52**									
TDR	-0.03	0.17	-0.03	-0.20								
TDL	-	0.15	-0.07	-0.24	0.98**							
LFR	0.42**	0.20	-0.21	-0.28*	0.20	0.20						
LFL	0.14	0.23	-0.19	-0.33*	0.34*	0.39**	0.38**					
LTR	0.29*	0.21	-0.05	0.09	0.04	0.04	0.39**	0.34*				
LTL	0.30*	0.25	0.03	-0.04	0.13	0.09	0.36**	0.20	0.39**			
VR	0.24	0.49**	-0.05	-0.03	0.15	0.12	0.30	0.01	0.13	0.19		
VL	0.26	0.69**	0.18	0.08	0.12	0.11	0.12	0.16	0.08	0.19	0.27	

* P<0.05; ** P<0.01 by Pearson's test.
GS - gait score; FDR - right leg femoral degeneration; FDL - left leg femoral degeneration; TDR - right leg tibial dyschondroplasia; TDL - left leg tibial dyschondroplasia; LFR - length of the right femur; LFL - length of the left femur; LTR - length of the right tibia; LTL - length of the left tibia; VR - valgus of the right leg; VL - valgus of the left leg.

Table 7 - Correlations between locomotion characteristics of broilers at 42 days of age

	Weight	GS	FDR	FDL	TDR	TDL	LFR	LFL	LTR	LTL	VR	VL
Weight												
GS	0.12											
FDR	-0.12	0.17										
FDL	-0.16	0.07	0.45**									
TDR	-0.07	0.22	-0.23	-0.05								
TDL	-0.06	0.24	-0.20	-0.07	0.98**							
LFR	0.16	-0.18	-0.46**	-0.26	0.30*	0.30*						
LFL	0.19	-0.06	-0.31*	-0.15	0.27	0.28	0.65**					
LTR	0.40	0.19	-0.24	0.32	0.25	0.24	0.51**	0.62**				
LTL	0.24	-0.02	-0.30	-0.04	0.07	0.07	0.52**	0.45**	0.49**			
VR	0.10	0.42	0.09	0.20	0.07	0.10	-0.03	0.01	-0.07	0.03		
VL	0.08	0.29	-0.06	-0.26	0.16	0.18	0.10	0.19	0.18	0.06	0.12	

* P<0.05; ** P<0.01 by Pearson's test.
GS - gait score; FDR - right leg femoral degeneration; FDL - left leg femoral degeneration; TDR - right leg tibial dyschondroplasia; TDL - left leg tibial dyschondroplasia; LFR - length of the right femur; LFL - length of the left femur; LTR - length of the right tibia; LTL - length of the left tibia; VR - valgus of the right leg; VL - valgus of the left leg.

Conclusions

The way broilers walk is not always affected by the incidence of some locomotion problems such as femoral degeneration or tibial dyschondroplasia. The gait score can be the same for birds with or without these lesions. The walking difficulty could be more related to problems of deformity of joints such as the valgus.

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References

ALMEIDA PAZ, I.C.L. Problemas locomotores e técnicas de mensuração. In: CONFERÊNCIA APINCO DE CIÊNCIA E

TECNOLOGIA AVÍCOLAS, 2008, Santos. **Anais...** Campinas: FACTA, 2008. p.57-68.

ALMEIDA PAZ, I.C.L.; GARCIA, R.G.; BERNARDI, R. et al. Selecting appropriate bedding to reduce locomotion problems in broilers. **Brazilian Journal of Poultry Science**, v.12, p.189-195, 2010.

BRUNO, L.D.G.; LUQUETTI, B.C.; FURLAN, R.L. et al. Influence of early qualitative feed restriction and environmental temperature on long bone development of broiler chickens. **Journal of Thermal Biology**, v.32, p.349-354, 2007.

GARNER, J.P.; FALCONE, C.; WAKENELL, P. et al. Reliability and validity of a modified gait scoring system and its use in assessing tibial dyschondroplasia in broilers. **British Poultry Science**, v.43, p.355-363, 2002.

KEALY, J.K. **Diagnostic radiology of the dog and cat**. 1.ed. Philadelphia: W.S. Saunders Company, 1987. 547p.

KESTIN, S.C.; KNOWLES, T.G.; TINCH, A.E. et al. Prevalence of locomotion problems in broiler chickens and its relationship with genotype. **Veterinary Record**, v.131, p.190-194, 1992.

NÄÄS, I.A.; ALMEIDA PAZ, I.C.L.; BARACHO, M.S. et al. Assessing locomotion deficiency in broiler chicken. **Scientia Agricola**, v.67, p.129-135, 2010.

SANOTRA, G.S.; LUND, J.D.; ERSBOLL, A.K. et al. Monitoring leg problems in broilers: a survey of commercial broiler production in Denmark. **World's Poultry Science Journal**, v.57, p.55-69, 2001.

SORENSEN, P.; SU, G.; KESTIN, S.C. Effects of age and stocking density on locomotion problems in broiler chickens. **Poultry Science**, v.79, p.864-870, 2000.

TSELEPIS, C.; HOLAYAND, J.A.; BABER, R.E. et al. Expression and distribution of cartilage matrix macromolecules in avian tibial dyschondroplasia. **Avian Pathology,** v.25, p.305-324, 1996.

WEEKS, C.A.; DANBURY, T.D.; DAVIES, H.C. et al. The behavior of broiler chickens and its modification by lameness. **Applied Animal Behaviour Science**, v.67, p.111-125, 2000.