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Performance of broiler chickens reared at two stocking densities and coir litter with different height[1]

Desempenho de frangos de corte criados em duas densidades de alojamento e cama de fibra de coco com diferentes alturas

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ABSTRACT - The objective of this study was to evaluate the performance of broiler chickens reared at two stocking densities and coir litter with different height. A total of 522 one-day male chicks were distributed in a completely randomized design in a 3×2 factorial arrangement, with three litter height (5, 10 and 15 cm) and two densities (10 and 13 birds/m^2), with six triplicates. The experimental period lasted 42 days, evaluating pH and litter moisture; performance; carcass traits; bone quality; and intensities of breast, hock and footpad lesions in the birds. Regarding the effect of density, a significant influence was observed only on performance, wherein the birds reared at the density of 13 birds/m^2 showed lower intake and weight gain and better feed conversion than those reared at the density of 10 birds/m^2. Irrespective of the rearing density and litter height, the hock and footpad lesions were frequent, and with severe intensity. It is concluded that coir with 5 cm height can be used to housing up to 13 birds/m^2; however, the high rate of hock and footpad lesions makes the use of coir in the evaluated form unfeasible.

Key words: Seedor index. Bone quality. Carcass yield. Poultry litter.

RESUMO - O objetivo deste trabalho foi avaliar o desempenho frangos de corte criados sob duas densidades de alojamento e cama de fibra do coco em diferentes alturas. Foram utilizados 522 pintos machos com um dia de idade, distribuídos em um delineamento inteiramente casualizado em esquema fatorial 3x2, sendo três espessuras de cama (5, 10 e 15 cm) e duas densidades de alojamento (10 e 13 aves/m^2) com seis repetições. O período experimental foi de 42 dias onde ao final foram avaliados o pH e a umidade da cama, o desempenho, as características de carcaça, a qualidade óssea e a intensidade das lesões no peito, joelho e coxim plantar das aves. Quanto ao efeito da densidade, observou-se influência significativa apenas sobre o desempenho, onde as aves criadas na densidade de 13 aves/m^2 apresentaram menor consumo e ganho de peso e melhor conversão alimentar que as criadas na densidade de 10 aves/m^2. Independente da densidade de criação e da altura da cama, as lesões no joelho e coxim plantar foram frequentes e com intensidade severa. Conclui-se que é possível o uso da fibra de coco com a altura de 5 cm para criar até 13 aves/m^2, contudo, o elevado índice de lesões no joelho e coxim plantar inviabiliza o uso da fibra de coco na forma avaliada.

Palavras-chave: Índice de Seedor. Qualidade óssea. Rendimento de carcaça. Cama aviária.

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INTRODUCTION

The marked growth of the Brazilian poultry industry has caused concerns regarding the availability of appropriate materials for the preparation of the poultry litter. Thus, in the absence of sufficient quantities, it has been necessary to acquire these materials from other regions, which raises the production costs.

For a material to be considered adequate to be used as poultry litter, it must withstand the management practices adopted in rearing as well as the continuous contact with the poultry. The material must have some properties such as preventing direct contact of the animals with the floor, promoting water absorption, incorporating excreta and feathers, and modifying characteristics of the medium, thereby providing comfort to the animals and improving their productive performance (ARAÚJO; OLIVEIRA; BRAGA, 2007).

In many cases the material utilized as litter is restricted to wood shavings, which has become increasingly scarce, and with a higher market value. Thus, obtaining it often depends on distant suppliers, which significantly elevates the cost.

In this context, studies on the use, management and production of litter, utilizing alternative materials such as agroindustrial by-products, crop residues, grass hays and coir, have been conducted by many researchers. However, in order for these materials to be used in poultry rearing, they must present similar or superior characteristics to those traditionally used like wood shavings (AVILA *et al*., 2008).

The population density is also an important aspect to be considered, because an excessive increase in the number of birds per square meter may cause a reduction of the growth rate, increased mortality, low-quality litter, and an increase in the incidence of lesions on the bird carcass, as well as leg problems (SANTANA *et al*., 2008).

Given the above, the objective of this research was to evaluate the effects of using coir with different height as poultry litter for broilers reared at two housing densities.

MATERIAL AND METHODS

The experiment was conducted in the Poultry Section of the Department of Animal Science of the Center for Agricultural Sciences at Universidade Federal do Ceará. Birds were housed in a masonry shed divided into forty-eight 1.5 m^2 (15 m × 10 m) pens longitudinally oriented towards the East-West direction, covered by clay tiles, with cemented floor, and a ceiling height of 3.5 m. One pendulum-type drinker and one tubular feeder was available inside each pen.

A total of 522 AgRoss-308 male chicks at one day of age, with an average initial weight of 50 g, were distributed in a completely randomized experimental design with a 3 × 2 factorial arrangement, totaling six treatments and six replicates per plot.

The studied factors were three litter height (5, 10 and 15 cm) and two housing densities (10 and 13 birds/m²). The different litter height was achieved by using 7.5, 12 and 15.5 kg of the fiber for the levels of 5, 10 and 15 cm, respectively.

Aiming to maintain the constant rearing density throughout the experiment, a group of birds was kept under the same conditions as each treatment, and as bird mortality occurred, the dead bird was replaced by one having similar body weight to that taken from the reserve pen.

The coir was acquired from the cooperative of coconut producers of Paraipaba/CE, Brazil. In the coconut processing industry, the husks of dry coconuts are transferred to an electric grinder, and the obtained material is left to dry in the sun and then stored. The crude fiber of the coconut husk is composed of long and short fibers and coir dust.

All birds received the same diet (Table 1), which was formulated to meet the nutritional requirements of each rearing phase (starter, grower and finisher), according to recommendations of Rostagno, Albino and Donzele (2011) for medium-performance broilers. The feed composition values proposed by those authors were also considered.

As initial care in the first days of life, heating was provided by a 60-W incandescent light bulb per pen. Aiming to maintain the adequate temperature and to prevent drafts, polyethylene curtains were installed externally around the shed, and managed by observing the behavior of birds.

The artificial illumination of the shed was provided by 40-W fluorescent light bulbs, which were distributed at 2.40 m above the floor, allowing for uniform illumination for all pens. The lighting program adopted during the entire experimental period was 24 h (natural + artificial) of light per day.

Regarding the feeding management, tubular chick feeders (5 kg capacity) were used in the first two weeks, and from 15 days of age this equipment was substituted for the tubular feeders with larger capacity. The feed was stirred twice daily to stimulate intake by the broilers. Water was supplied *ad libitum* in pendulum-type drinkers, and all the aforementioned equipment was cleaned twice daily — in the early morning and late afternoon.

Table 1 - Centesimal and calculated nutritional composition of the experimental diet supplied to the broilers in the starter, grower and finisher phases

Ingredients (%)	Phase		
	Starter (1 to 21 days)	Grower (21 to 35 days)	Finisher (35 to 42 days)
Corn	58.033	63.170	67.310
Soybean meal	36.073	31.200	26.790
Soybean oil	1.876	2.350	3.070
Dicalcium phosphate	1.742	1.310	1.180
Limestone	1.220	1.110	1.020
Common salt	0.468	0.380	0.330
DL-methionine	0.186	0.080	0.000
Vitamin-mineral mixture	0.400	0.400	0.300
Total	100.000	100.000	100.000
Calculated nutritional composition			
Metabolizable energy (Mcal/kg)	2.950	3.050	3.150
Crude protein (%)	21.400	19.400	17.700
Calcium (%)	0.920	0.869	0.790
Available phosphorus (%)	0.410	0.349	0.320
Sodium (%)	0.190	0.190	0.170
Total lysine (%)	1.150	1.020	0.900
Total methionine (%)	0.460	0.390	0.370
Total methionine + cystine (%)	0.830	0.700	0.630
Total threonine (%)	0.830	0.760	0.690
Total tryptophan (%)	0.260	0.240	0.210

[1]Vitamin-mineral supplement (per kg): antioxidant - 25 g; copper - 2,000 mg; zinc - 17,500 mg; iron - 12,500 mg; iodine - 187.50 mg; manganese - 18.750 mg; growth promoter - 25.50 g; coccidiostat - 27.50 g; selenium - 75 mg; gentian violet - 3 g; vit. A - 2,000,000 IU; vit. B1 - 450 mg; vit. B12 - 3.000 mcg; vit. B2 - 1,500 mg; vit. B6 - 700 mg; vit. D3 - 500,000 IU; vit. E - 3,750 mg; vit. K3 - 450 mg; biotin - 15 mg; folic acid - 250 mg; pantothenic acid - 3,750 mg; choline - 105,000 mg; niacin - 10,000 mg; excipient q.s. - 1,000 g

Birds were vaccinated against Newcastle disease via the drinking water on the seventh day of rearing.

The temperature and relative humidity inside the shed were measured daily using a maximum and minimum thermometer and a thermohygrometer, respectively. The data were recorded daily at 8h00, 13h00 and 16h00.

The litter management was achieved by raking the material with a harrow twice weekly, always in the morning.

The evaluated performance parameters were: feed intake (g/bird), weight gain (g/bird) and feed conversion (g/g). At the end of each phase, feed and birds were weighed to evaluate their performance.

Feed intake was calculated as the weight difference between the amount of feed supplied at the beginning and the leftovers at the end of the experiment. Weight gain was determined as the difference between the final and initial weights of the birds in each experimental unit. Feed conversion was calculated by dividing feed intake by the weight gain of each experimental unit.

The evaluated carcass traits were: yields (%) of carcass, breast and drumstick + thigh. For this purpose, at the end of the experimental period (42 days of age), after a feed-deprivation period of eight hours, the birds from all pens were weighed, and then three birds per plot, having a live weight close to the average of the plot, were chosen. After being identified, they were taken to the slaughterhouse, where they were slaughtered by cervical dislocation, followed by bleeding, scalding, plucking and evisceration.

Clean carcasses, without neck, feet and viscera, were weighed to determine the carcass yield in relation to the bird live weight. Next, the sections were made to remove the breast and drumstick + thigh, which were weighed to calculate the yield in relation to the hot carcass weight.

After being weighed, drumsticks and thighs were deboned, and the bones were frozen in a freezer at –20 ºC. Subsequently the cuts were taken out of the freezer and left to defrost in a domestic refrigerator (temperature of 4 ºC for 12 h), and then placed on a countertop for the material to reach room temperature. Femur and tibia were properly identified and immersed in boiling water for 10 min. Subsequently, they were cleaned with a scalper, according to the methodology described by Bruno (2002).

The length of the femur and tibia was measured using a digital caliper, and the weight was obtained using a precision scale (0.01 g). Bone density was evaluated using the Seedor Index, obtained by dividing the weight (mg) by the length (mm) of the evaluated bone (SEEDOR; QUARTUCCIO; THOMPSON, 1991). The bone resistance and deformity parameters were determined in the bone *in natura* (tibia and femur) with a triaxial mechanical press (Testop/Ronald top) with 150 kg capacity. The bones were placed horizontally on a wood support, and then a force was applied at the center of each bone. The maximum strength applied on the bone until breakage was considered the shear strength (kgf/cm²), which was measured using a digital extensometer. Bone deformity (mm) was measured by recording, in an analog extensometer, the flexion of each bone in relation to its horizontal position until its breakage by the action of the applied force.

Evaluations of breast, hock and footpad lesions in the birds were performed at 42 days. Initially all birds from each plot were evaluated for presence or absence of lesions in each of the assessed regions, with results expressed in percentage.

The intensity of the lesions was assessed according to the methodology described by Oliveira; Goulart and Silva (2006). To this end, all birds that showed lesions were identified in each plot. Later, three birds were randomly chosen from each plot, having the average weight of the plot, totaling 108 birds. These were identified with water-based gouache paint for subsequent evaluations.

For the analyses of hock and footpad lesions, the following scores were utilized: 0 - normal (no burns, crusts or lesions); 1 - burnt footpad (dermis only); 2 - footpad with crusts (healed lesion) on one foot or both feet; and 3 - footpad with lesion (open wound) in one foot or both feet. For the breast lesions, scores were: 0 - no lesion; 1 - with lesion, but no inflammation; and 2 - with lesion and inflamed. The lesions were then recorded on appropriate files for subsequent tabulations and analyses.

To evaluate the pH and moisture of the litter, a composite sample of each pen was prepared, obtained from the collection of three sub-samples harvested in three different points in each pen, avoiding the areas close to and below the feeders and drinkers. These samples were subsequently homogenized and packed hermetically.

To determine the pH, a 30 g sample was macerated in a beaker, then 250 mL deionized water were added, and the sample was agitated for five minutes. After this procedure, it was left to rest for 30 min before reading with a pH meter.

The methodology proposed by Silva and Queiroz (2002) was used to determine the moisture content.

Statistical analysis of the data was performed on the SAS 9.2 software. The data were initially subjected to the Shapiro-Wilk test to check normality of residues and Levene's test for homogeneity among the variances.

The proportion of birds with lesions did not meet the normality and homogeneity assumption, and so the effects were compared using the Chi-squared test (χ^2) at 5% probability.

Lesion-intensity data were transformed according to log (x + 1) so as to reduce the variation among the scores. These data and those obtained for the other variables were subjected to analysis of variance using the ANOVA procedure of the Statistical Analysis System 2004, version 9.2 software in a factorial model in which the litter-thickness and housing-density factors and respective interactions between them were included in the models. Means were compared by the SNK test at 5% probability.

RESULTS AND DISCUSSION

The moisture and pH of the litter at the end of the experimental period are shown in Table 2. According to the statistical analysis of the data, there was no significant interaction between the rearing-density and litter-thickness factors on the litter moisture and pH. It was also observed that these variables were not significantly influenced by the rearing density or by the litter thickness separately.

In the literature, the litter pH and moisture are commonly reported as factors that affect the litter quality and which can vary according to the population density, the material utilized as bedding, the type of drinker and the bird health, among others. Furtado *et al*. (2006) reported that a larger number of birds increases the litter moisture and elevates the number of irritant substances on it. In this context, the results obtained for the coir litter at the end of the rearing cycle demonstrated that the number of birds housed and the thickness of the material utilized were not sufficient to change the pH and moisture of the litter. We can thus infer that the litter quality, measured by those parameters, did not differ among the evaluated rearing densities and height.

Table 2 - Moisture and pH of the coir litter for broilers reared at two densities and with three litter height

Factor	Variables	
	pH	Moisture (%)
Litter height (cm)		
5	8.24	41.18
10	8.26	39.79
15	8.24	40.56
Density (birds/m²)		
10	8.23	40.11
13	8.26	40.98
Effects - ANOVA[1]	P-value	
t	0.9737	0.7174
Density	0.7049	0.5301
Height × Density	0.6743	0.5898
CV[2] (%)	3.33	10.00

There was no statistical difference according to the SNK test at 5% probability ($p>0.05$); [1]Analysis of variance; [2]CV - coefficient of variation

The moisture values determined for the different treatments are close to those reported in the literature for other materials. Avila *et al*. (2008) studied several alternative materials to substitute wood shavings and found a variation in pH from 8.4 to 9.2. Furtado *et al*. (2006) detected moisture values of up to 40.35%. However, Furtado *et al*. (2006) reported that litter-moisture values between 25 and 35% are considered favorable to rearing broilers.

Based on the obtained results for performance (Table 3), there was no significant interaction between the studied factors on the performance parameters evaluated. It was also noted that litter thickness did not influence significantly feed intake, weight gain or feed conversion.

However, for the housing density, it was observed that the birds reared at a density of 13 birds/m² consumed less feed and consequently obtained a lower weight gain,

Table 3 - Performance of broilers reared at two densities and with different coir-litter height

Factor	Variables		
	Feed intake (g/bird)	Weight gain (g/bird)	Feed conversion
Litter height (cm)			
5	4474.04	2537.38	1.77
10	4460.25	2472.83	1.80
15	4481.34	2564.62	1.75
Density (birds/m²)			
10	4675.18 A	2573.58 A	1.82 B
13	4255.86 B	2473.27 B	1.72 A
Effects - ANOVA[1]	P-value		
t	0.9510	0.1763	0.0913
Density	0.0001	0.0185	0.0001
Height × Density	0.9786	1.0000	0.1745
CV[2] (%)	3.54	4.55	2.89

In the column, means followed by different letters differ by the SNK test; [1]Analysis of variance; [2]CV - coefficient of variation but showed better feed conversion than birds reared at the density of 10 birds/m^2.

Reduction of feed intake with increased rearing density has been reported by other researchers (ARAÚJO; OLIVEIRA; BRAGA, 2007; MORTARI *et al*., 2002). According to them, this reduction is linked to the limited mobility and difficulty to access the feeders due to the smaller physical space in the shed per housed bird. Another noteworthy factor is the feeder space per housed bird, which changes with the different densities.

Because weight gain in broilers is, under normal conditions, directly proportional to the intake of nutrients, we can infer that the reduction of weight gain observed in birds reared at a higher housing density is associated with the lower feed intake by them.

Just as in the present research, Mortari *et al*. (2002) and Skrbic *et al*. (2009, 2011) reported a reduction in weight gain of broilers as the stocking rate was increased. Yet, some researchers (ARAÚJO; OLIVEIRA; BRAGA, 2007; MOREIRA *et al*., 2004; LANA *et al*., 2001) have observed that although the increase in rearing density promoted a significant decrease in intake, this fact was not sufficient to compromise weight gain by the birds. According to those authors, the similar weight gain obtained with lower feed intake can be explained by the fact that the metabolizable energy that would be spent on locomotion is used for weight gain instead, thereby contributing to maintain the daily weight gain of birds reared at a higher density.

This re-routing of the metabolizable energy according to the housing density may explain the better feed conversion of birds reared at a higher density (13 birds/m^2) as compared with those reared at a lower density (10 birds/m^2). As the bird mobility was reduced the loss of energy for this purpose reduced as well, and then it was directed towards weight gain, which in turn contributed for the observed reduction in weight gain not to be sufficient to compromise the feed conversion.

Better feed conversion in birds reared at a higher density has often been associated with the maintenance of weight gain, despite the reduction of feed intake (ARAÚJO; OLIVEIRA; BRAGA, 2007; LANA *et al*., 2001). Some other researchers (MOREIRA *et al*., 2004; MORTARI *et al*., 2002), however, did not observe influence of rearing density on feed conversion, although feed intake and weight gain decreased. This indicates that the problem of weight gain with an increase in rearing density is not in the use of the nutrients of the diet, but rather caused by the reduced intake.

It should be stressed that the variability in the results for the effect of density may have been due to the evaluation conditions, especially the climatic conditions of the rearing environment, which influence the responses obtained for the same rearing density. According to Skrbic *et al*. (2009), this would explain the fact that some studies report differences in performance between the densities of 10 and 13 birds/m^2 and some do not. However, for some researchers, the adverse effects of increased density become clearer when there is a larger difference between the evaluated densities, because significant differences in performance between birds reared at the densities of 10 and 16 birds/m^2 have been commonly reported.

With regard to the effect of litter thickness on bird performance, the obtained results are similar to those reported by Sorbara *et al*. (2000), who evaluated the use of citrus-pulp litter with 7 and 10 cm thickness and found that litter thickness did not affect the performance of broilers reared at the housing densities of 10 and 14 birds/m^2.

Concerning the carcass traits (Table 4), there was no significant interaction between the litter-thickness and housing-density factors or significant effects of them separately on the yields of carcass, breast or drumstick+thigh.

The results obtained for the effect of density on the carcass traits in the present research are similar to some reports of the literature. Lana *et al*. (2001), studying the densities of 10, 12 and 16 birds/m^2, and Moreira *et al*. (2001), evaluating the densities of 10, 13 and 16 birds/m^2, did not find differences for the yields of the carcass and main parts (breast and legs). Moreira *et al*. (2004), in turn, observed the variation in rearing density from 10 to 16 birds/m^2 did not affect the yield of carcass or parts. However, Skrbic *et al*. (2011) reported significant differences in the breast yield of birds housed at different rearing densities, observing greater yield for birds reared at the density of 12 birds/m^2 as compared with 16 birds/m^2. Nevertheless, these authors did not observe significant differences for drumstick and thigh yield.

Analyzing the growth and quality of the bones from the legs of the broilers (Table 5), no significant interaction between the litter-thickness and housing-density factors or separate effects of these factors were observed on weight, length, Seedor Index and shear strength of their femur and tibia bones.

Reduction of the area available for the birds has been reported as a causative agent of greater incidence of leg problems in broilers due to the lack of exercise, which culminates in lower muscle and bone development (VENTURA; SIEWERDT; ESTEVEZ, 2010; SANTANA *et al*., 2008). Therefore, it can be inferred that changes in the evaluated litter height and housing densities were not sufficient to cause alterations in the development and quality of bone tissue in the broilers.

The no-influence of rearing density on the bone growth in broilers was also reported by Oliveira *et al*. (2012), who observed that the densities of 10 and 16 birds/m^2 did not affect the bone-related variables of the three broiler strains evaluated. Buijs *et al*. (2012), however, found that the rearing density influenced three bone characteristics of the tibia: its length, bowing and shear strength. As the density was increased, its resistance reduced and the length decreased due to the greater curvature of the bone.

Regarding the frequency of lesions in birds (Table 6), no significant effect of litter thickness or housing density separately was observed on the total proportion of birds showing breast, hock and footpad lesions.

Table 4 - Carcass traits of broilers reared at two densities and with different coir-litter height

Factor	Variables1		
	CY (%)	BY (%)	DTY (%)
Litter height (cm)			
5	75.04	31.77	31.62
10	75.13	32.01	32.22
15	75.44	31.92	31.44
Density (birds/m^2)			
10	74.96	31.81	32.02
13	75.45	31.99	31.50
Effects - ANOVA[2]	P-value		
t	0.8415	0.8807	0.2644
Density	0.4051	0.6516	0.2032
Height × Density	0.3047	0.2769	0.9546
CV[3] (%)	2.33	3.67	3.79

There was no statistical difference according to the SNK test at 5% probability ($p > 0.05$); [1] Carcass yield (CY); breast yield (BY); drumstick+thigh yield (DTY); [2]Analysis of variance; [3]CV - coefficient of variation

Table 5 - Bone growth and quality in broilers reared at two densities and with different coir-litter height

Factor	Variables			
	Weight (g)	Length (mm)	Seedor Index (mg/mm)	Resistance (kgf/cm²)
Femur				
Litter height (cm)				
5	9.52	75.42	126.22	15.73
10	9.44	76.08	124.08	15.80
15	9.65	76.70	125.81	15.80
Density (bird/m^2)				
10	9.74	76.61	127.13	15.64
13	9.34	75.51	123.69	15.90
Effects - ANOVA[1]	P-value			
t	0.837	0.298	0.826	0.997
Density	0.175	0.104	0.283	0.730
Height × Density	0.199	0.354	0.149	0.405
CV[2] (%)	9.12	2.56	7.75	14.25

Continuation Table 5

Tibia				
Litter height (cm)				
5	12.23	99.60	122.79	13.21
10	12.19	100.80	120.93	13.81
15	12.46	101.10	123.24	13.26
Density (bird/m²)				
10	12.26	100.74	121.69	13.26
13	12.32	100.20	122.95	13.59
Effects - ANOVA[1]	P-value			
t	0.807	0.500	0.779	0.799
Density	0.873	0.634	0.673	0.692
Height × Density	0.660	0.828	0.628	0.934
CV[2] (%)	9.02	3.30	7.38	18.20

There was no statistical difference according to the SNK test at 5% probability (p>0.05); [1]Analysis of variance; [2]CV - coefficient of variation

Table 6 - Frequency (%) of breast, hock and footpad lesions observed in broilers reared at two densities and with different coir-litter height

Factor	Frequency of callosity					
	Breast		Hock		Footpad	
	Yes	No	Yes	No	Yes	No
Litter height (cm)						
5	75.00	25.00	8.30	91.70	0.00	100.00
10	83.30	16.60	22.20	77.80	2.80	97.20
15	86.10	13.80	22.20	77.80	0.00	100.00
Density (birds/m²)						
10	77.80	22.20	11.10	88.90	1.90	98.10
13	85.10	14.90	24.10	75.90	0.00	100.00
Chi-squared test	P-value					
Litter height	0.534		0.269		0.170	
Density	0.277		0.086		0.693	

There was no statistical difference according to the Chi-squared test at 5% probability (p>0.05)

Regarding the intensity of the lesions (Table 7), there was no significant interaction between the litter-thickness and housing-density factors or significant effect of them separately on the severity the breast, hock and footpad lesions in the broilers.

The results obtained in our study for the effects of housing density on lesions in broilers are partially in agreement with some reports found in the literature. Addressing breast lesions in broilers, Oliveira *et al*. (2012) reported that they were not influenced by the rearing density (10 vs 14 birds/m²), whereas Kun, Uluocak and Karaman (2009) reported a decrease in their incidence as the density was increased.

With respect to hock and footpad lesions, Oliveira *et al*. (2012) and Ventura, Siewerdt and Estevez (2010) reported an increase in incidence and severity of lesions in these regions as the density was increased. In addition to increased callousness in the hock, Kun, Uluocak and Karaman (2009) stated that the increased housing density elevated fracture bone problems during slaughter.

Table 7 - Average scores of breast, hock and footpad lesions in broilers reared at two densities and with different coir-litter height

Factor	Evaluation site		
	Breast	Hock	Footpad
Litter height (cm)			
5	0.39	2.25	2.87
10	0.25	2.06	2.78
15	0.17	2.14	2.91
Density (birds/m²)			
10	0.29	2.26	2.78
13	0.24	2.10	2.91
Effects - ANOVA[1]	P-value		
t	0.3898	0.5433	0.2598
Density	0.5766	0.2273	0.0725
Height × Density	0.1225	0.2897	0.0647
CV[2] (%)	14.04	9.81	3.09

[1]Analysis of variance; [2]CV - coefficient of variation

However, unlike these statements and similarly to the present study, Bonamigo, Silva and Molento (2011) did not observe significant differences in the incidence of foot lesions between hens reared at the densities of 10 and 15 birds/m².

The incidence of types of lesions in chickens has been commonly associated with the quality of the material used as bedding in terms of particle size, softness and capacity to absorb and lose moisture (ARAÚJO; OLIVEIRA; BRAGA, 2007; OLIVEIRA *et al*., 2012). Hence, these traits should be considered by the technicians when determining the litter thickness, the rearing density and the litter management to raise the lot. In this scenario, the results in obtained the current study demonstrate that the incidence of breast, hock and footpad lesions was not influenced by the evaluated coir-litter thickness or the rearing densities.

On the other hand, it should be stressed that the high incidence of lesions and the high scores of hock and footpad lesions of the birds in this experiment, regardless of the litter thickness and rearing density, makes us wonder if the material or the size of the particles of the litter utilized in the present study are suitable for use.

It is possible that the long length of the coconut fibers contributed to the increase in the leg lesions, because over the course of the experiment it was possible to observe that soon after the litter was managed, it started to show signs of compaction, which increased as the birds moved, forming a kind of carpet due to the intertwining of the fibers. Thus, in addition to the roughness of the material, it was difficult to mix the excreta in the litter, which left this material into direct contact with the birds for a longer time.

However, if we consider that performance, carcass traits and bone development were not influenced by the lesions presented, it is inferable that further research should be carried out to better study this material.

CONCLUSION

The coir litter with 5 cm of height can be used to housing up to 13 birds/m². However, the high incidence of hock and footpad lesions indicates the unfeasibility of using this material in the form it was assessed.

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