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Paper products as litter materials for broilers: performance, carcass defects, footpad lesions^{1,2}

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ABSTRACT

Recycled paper products were evaluated as litter material for broilers; parameters were growth performance, carcass quality, and footpad problems. One hundred sixty-eight broiler chicks were raised to market age (42 d) in an open-sided poultry house located at the Lajas Agricultural Experiment Station Small Animal Research Farm. Birds were assigned to 12 floor pens bedded with either rice hulls (RH) as control; a 50:50 mix of RH and shredded white paper (SWP); or a 50:50 mix of RH and shredded newspaper (SNP) according to a completely randomized design replicated four times. Traits measured were body weight, feed intake, feed conversion, carcass yield, breast blister score, footpad burn score, and mortality. Litter moisture percentage was assessed at 14, 28, and 42 d of age. Litter material had no influence on body weight, breast blister score, or bird mortality. However, birds raised on SWP had lower feed intake and higher body weight than those raised on RH and SNP. No significant differences in feed conversion were observed among treatments from 7 to 28 d of age. At 35 and 42 d, birds raised in SWP had significantly lower feed conversion than controls,

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whereas feed conversion of birds raised in SNP did not differ from that of the other treatments. No differences were found for carcass yield among treatments. At all sampling times, litter moisture percentage was significantly higher in SNP than in the control. No litter caking problems were observed in any of the treatments. Significant differences in footpad burn scores were observed among all treatments, with birds raised on SNP having higher scores (severer lesions), than those on SWP and RH. The results suggest that recycled paper products could be an excellent alternative bedding material for broilers. The use of SWP as litter appears to improve broiler performance and reduce the incidence of footpad problems.

Key words: broilers, paper, litter, performance, breast blisters, footpad burns

RESUMEN

Productos de papel como material de camada de pollos de engorde: desempeño productivo, defectos de la canal y lesiones del cojín de las patas

Se evaluó el uso de productos de papel reciclado como material para camada de pollos parrilleros y sus efectos sobre el crecimiento, desempeño productivo y lesiones en las patas. Se criaron 168 pollos parrilleros hasta la edad de mercado (42 d) en un galpón con laterales abiertos localizado en la Granja Experimental para Animales Pequeños de la Estación Experimental Agrícola de Lajas. Las aves se asignaron a 12 jaulas de piso con camada de cascarilla de arroz (CDA) como control; una mezcla 50:50 de CDA y papel blanco triturado (PBT); o una mezcla 50:50 de CDA y papel de periódico triturado (PPT) en un diseño completamente aleatorizado repetido cuatro veces. Se evaluó el peso corporal, consumo de alimento, conversión alimenticia, rendimiento de la canal, laceraciones de la pechuga, quemadura del cojín de la pata y la mortalidad. El porcentaje de humedad de la camada se determinó a los 14, 28 y 42 d de edad. El material utilizado como camada no afectó el peso corporal, consumo de alimento, laceraciones de la pechuga ni la mortalidad de las aves. Sin embargo, los pollos criados en PBT mostraron un menor consumo de alimento y un mayor peso corporal al compararse con aquellos criados en CDA y PPT. No se observaron diferencias significativas en la conversión de alimento de los siete a los 28 d de edad. A los 35 y 42 d, los pollos criados en PBT mostraron una menor conversión de alimento que las aves criadas en CDA, mientras que la conversión de alimento de los pollos criados en PPT fue similar a la de los demás tratamientos. No se encontraron diferencias en el rendimiento de la canal entre los tratamientos estudiados. En todos los periodos de muestreo, el porcentaje de humedad de la camada fue significativamente mayor en PPT que en las demás camadas. No se observaron problemas de áreas húmedas en ninguna de las camadas estudiadas. Se observaron diferencias significativas en quemaduras del cojín de las patas, siendo la incidencia mayor en los pollos criados en PPT, menor en CDA e intermedia en aquellos criados en PBT. Los resultados sugieren que los productos de papel reciclado pueden ser una excelente alternativa como material de camada para el levante de pollos parrilleros. La utilización de PBT aparenta mejorar el desempeño productivo y reducir la incidencia de quemaduras del cojín de las patas.

Palabras clave: parrilleros, papel, camada, desempeño, lesiones pechuga, quemaduras cojín de la pata

INTRODUCTION

The broiler industry is the second largest agricultural sector of Puerto Rico (PRDA, 2002). As this industry continues to grow on the

island, traditional litter materials such as rice and coffee hulls will become scarce and costly, representing a potential concern. Thus, the need to search for alternative litter materials is of great importance.

In Puerto Rico, 770,000 t of discarded paper and cardboard is generated each year, thus making these products the principal waste of landfills (PRSWA, 2004). Generally, these products are available free to the broiler industry and may be of benefit because recycled paper products can be useful materials for bedding. Malone et al. (1982) reported that broilers reared on shredded newspaper litter had higher body weights at 28 and 49 d than those reared on sawdust. However, paper litter showed significantly higher moisture content and more caking problems than sawdust, and the incidence of breast blisters was greater in broilers raised on processed cardboard litter. On the other hand, Martínez and Gernat (1995) reported no effect of paper litter treatments on body weight gain (BW), feed intake (FI), feed conversion (FC), or mortality, nor were differences found for litter moisture percentage (LMP) among treatments. Lien et al. (1992) reported that broilers reared on recycled paper chips had growth performance similar to that of those reared on pine shavings. Moreover, Malone et al. (1983) and Malone and Chaloupka (1983) reported that the use of paper-based litter significantly improved BW, FC, and life expectancy of broilers compared to the use of sawdust. Therefore, recycled paper products appear to be a potential alternative litter material for the local broiler industry. These materials could be considered for use by the industry if they cause no adverse effects on production and carcass quality, and if other factors such as availability, handling, and cost are favorable. The objective of this study was to evaluate the effects of litter from recycled paper products as litter materials on growth performance, carcass quality, and foot pad problems of broilers.

MATERIALS AND METHODS

One hundred sixty-eight broiler chicks were raised under standard commercial conditions in an open-sided naturally ventilated poultry house at the Lajas Agricultural Experiment Station Small Animal Research Farm. Birds were randomly assigned to three treatments, with four replicate pens per treatment. Treatments consisted of pens bedded with either 6.4 cm of rice hulls (RH) as control; a 50:50 mixture of RH and shredded white paper (SWP); or a 50:50 mixture of RH and shredded newspaper (SNP). Chicks were placed at a stocking density of 0.85 m² in pens containing one bell-type feeder and nipple drinkers. Birds were raised under a 24-h light schedule and fed ad libitum for the duration of the study.

We used a three-phase feeding regime of starter (0 to 14 d), grower (15 to 28 d), and finisher (29 to 42 d) diets. Diets were corn- and soybean meal-based and formulated to meet or exceed the National Research Council nutrient recommendations for broilers (NRC, 1994). Table 1 shows the percentage composition and nutrient content of diets. Once a week, FI and BW were measured, and at the end of each phase 200 g of litter from each pen was sampled and LMP assessed. Litter condition was visually monitored on a daily basis and assessed for caking.

At 42 d, 60 birds were processed for carcass traits. Ten hours prior to processing, 20 birds per treatment were randomly selected, wing banded, weighed, and placed in coops without access to feed or water. Birds were hung in metallic funnels and bled to death from a single cut severing the carotid artery and jugular vein. After exsanguination, birds were scalded, mechanically plucked, weighed, and manually eviscerated. Carcasses were chilled for 5 h in an ice slush tank, after which time they were weighed. Carcass weight (CW) and carcass yield (CY) were calculated as a percentage of live BW. Also, the gizzard weight

TABLE 1. *Percentage composition and nutrient content of experimental diets.*

Ingredient	Starter (0-14 d)	Grower (15-28 d)	Finisher (29-42 d)
Ground corn (%)	49.65	59.87	66.89
Soybean meal (%)	41.45	33.30	27.82
Vegetable oil (%)	5.55	3.69	2.37
Vitamin and mineral premix ¹ (%)	0.50	0.50	0.50
Limestone (%)	1.07	1.03	0.95
Salt (%)	0.25	0.25	0.25
Dicalcium phosphate (%)	1.54	1.36	1.21
Nutrient content (calculated)			
CP (%)	23.00	20.00	18.00
ME (kcal/kg)	3,100	3,100	3,100
Crude fat (%)	7.45	5.92	4.84
Crude fiber (%)	3.85	3.47	3.22
Ca (%)	1.00	0.90	0.80
Total P (%)	0.71	0.65	0.60
Available P (%)	0.45	0.41	0.37
Methionine (%)	0.51	0.47	0.45
Cystine (%)	0.37	0.33	0.31
Lysine (%)	1.32	1.11	0.97

¹Composition of vitamin and mineral premix per kilogram of diet: Mn, 15 g; Zn, 12 g; Fe, 9 g; Cu, 1.5 g; I, 150 mg; Se, 40 mg; vitamin A, 2,000 IU; vitamin D₃, 450 IU; vitamin E, 3 g; vitamin K, 300 mg; biotin, 10 mg; choline, 80 g; folic acid, 200 mg; niacin, 6 g; vitamin B₁₂, 2 mg; thiamin, 100 mg; riboflavin, 1.5 g; pantothenic acid, 2.2 g; pyridoxine, 100 mg.

(GW) was used as an indicator of litter consumption. Data of breast blisters (BB) and footpad burns (FPB) were recorded by assigning a score going from 1 for less to 5 for more severe lesions.

Data were analyzed for statistical significance according to a Complete Randomized Design by ANOVA using the General Linear Model procedures of SAS® (SAS Institute, 1990). The Tukey's test option of SAS® was used to compare and separate treatment means when significant by ANOVA. All statements of significance are based on a probability of $P \leq 0.05$.

RESULTS AND DISCUSSION

Litter treatments had no effect on BW except at 21 d of age (Table 2). At this age, broilers reared in SWP litter were heavier than controls, whereas BW of those raised in SNP did not differ from that of the other

TABLE 2. *Effect of litter material on body weight, accumulative feed intake and feed conversion of broilers.*

Age (d)	Litter treatment			SEM	Probability
	RH	SWP	SNP		
Individual body weight (g)					
1	39	39	40	0.3	0.58
7	115	132	124	4.9	0.10
14	298	333	324	9.5	0.07
21	632 b ¹	680 a	634 ab	11.7	0.03
28	1,085	1,154	1,117	21.8	0.14
35	1,499	1,570	1,551	33.8	0.35
42	1,997	2,075	1,990	37.1	0.25
Accumulative feed intake (g)					
7	123	126	131	11.8	0.90
14	464	480	499	31.3	0.74
21	1,188	1,079	1,118	67.9	0.54
28	2,199	1,951	2,075	124.5	0.41
35	3,449	3,021	3,097	140.9	0.13
42	4,146	3,657	3,766	177.3	0.18
Feed conversion (g feed/g BW)					
7	1.07	0.96	1.06	0.10	0.69
14	1.56	1.45	1.54	0.09	0.62
21	1.88	1.59	1.76	0.10	0.17
28	2.03	1.69	1.86	0.11	0.16
35	2.30 a	1.92 b	2.01 ab	0.09	0.04
42	2.07 a	1.76 b	1.90 ab	0.07	0.03

¹Means within a row bearing different letters are significantly different ($P \leq 0.05$).

treatments. From seven to 35 d of age, there was a constant ranking of the three treatments. Birds reared on SWP also had numerically lower FI (21 to 42 d) in addition to the higher BW than those reared in RH litter and SNP. No significant differences in FC were observed among treatments from seven to 28 d of age. However, after 35 d, birds raised in SWP litter had significantly lower FC than controls, whereas FC of birds raised in SNP litter did not differ from that of the other treatments (Table 2). No differences in CW, CY, or GW were observed among treatments (Table 3). Gizzard weight was used as an indicator of litter consumption as gizzard size has been shown to be correlated with litter intake (Deaton et al., 1993). The lack of differences in gizzard size suggests that consumption of litter was equal for all treatments. Although bird mortality was not affected by litter treatment, SWP litter had numerically lower mortality losses than RH or SNP.

At all sampling times, LMP (Figure 1) was significantly higher in SNP than in RH, whereas LMP values of SWP were not different from those of RH at 14 d nor from those of SNP at 42 d; at 28 d LMP was similar to that of both of the other treatments. It is important to emphasize that no litter caking problems were observed throughout this study. Caking is one of the principal problems reported in the literature with the use of this recycled material for litter. Figure 2 shows that significant differences in footpad burn scores (FPBS) were observed among treatments. Birds raised in SNP litter had higher FBPS, followed by those in SWP, and the lowest FBPS in RH litter. The incidence of FPB observed in the present study could be attributed to the differences observed in LMP; the higher the LMP, the higher the FPBS observed. High levels of LMP are associated with elevated levels of ammonia in the litter mass, which in turn increases the likelihood of lesions in the footpad. Likewise, although no differences were observed among treatments for breast blister scores (BBS), the tendency was toward a concomitant increase in these lesions with increased litter moisture. In that aspect, May and

TABLE 3. *Effect of litter material on carcass weight, carcass yield, gizzard weight, and mortality of broilers.*

Trait	Litter Treatment			SEM	Probability
	RH	SWP	SNP		
Carcass weight (g)	1,520 ¹	1,560	1,493	44.70	0.57
Carcass yield (%)	66.8	67.3	66.2	0.48	0.28
Gizzard weight (g)	49.9	47.0	46.3	2.30	0.51
Mortality (%)	5.35	3.57	5.35	3.44	0.91

¹Means within a row bearing different letters are significantly different ($P \leq 0.05$).

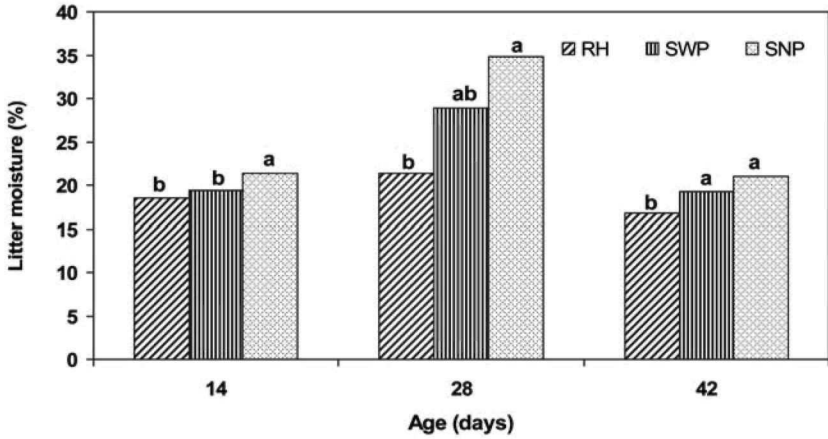


FIGURE 1. Mean litter moisture percentage of rice hulls (RH), RH and shredded white paper mixture (SWP), and RH and shredded newspaper mixture (SNP) litters at 14, 28, and 42 d.

Noles (1965) and Wiseman and Beane (1965) reported a positive correlation between breast blisters and LMP. Malone et al. (1982) found that shredded newspaper litter resulted in higher LMP and caking problems, but BBS were similar to those of broilers raised in sawdust litter. Burke et al. (1993) reported that the incidence of leg problems and breast blisters was similar for litters composed of various ratios of wood shavings

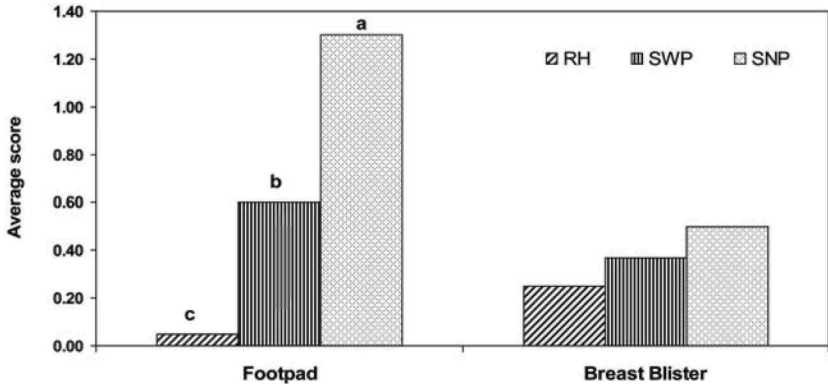


FIGURE 2. Mean effects of litter treatment on footpad burn and breast blister scores based on a scale from 1 (best) and 5 (worst) for broilers in pens with rice hulls (RH), RH and shredded white paper mixture (SWP), and RH and shredded newspaper mixture (SNP) litters.

mixed with paper. Nevertheless, the incidence of BB and FPB found in the present study was low. Lesions were small and no severe cases of breast blisters or footpad burns were observed.

CONCLUSION

The results of this study indicate that recycled paper products could be a potential alternative litter material for broilers. Broilers raised with these litter products showed similar or superior performance to those reared in a traditional RH litter. The use of a SWP mixture litter resulted in good broiler performance and reduced footpad problems. The use of these paper products should be considered by the local industry because of their low cost, abundance, absorbent properties, and lack of negative effects on bird performance.

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