



Research Article

Alternative Bedding Materials to Improve Growth Performance and Welfare of Broilers

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Abstract

Objective: The aim of this study was to evaluate the effects of five litter types on the growth performance and some welfare indicators (pododermatitis, hock burns, breast blister and feather cleanliness) in broilers over rearing cycle of 42 days.

Materials and Methods: The used litter types were wood shaving, sawdust, standard quality straw, low quality straw and crop residues. A total of six hundred one day-old male broilers (Cobb 700) were randomly allocated to 5 treatments with 6 replicates of 20 chicks each.

Results: Results showed that at the age of 7 day, the FCR and body weight were significantly improved (-5%, $p = 0.002$; +9.5%, $p = 0.015$ respectively) in broilers reared on sawdust. Furthermore, the heavier BW observed in broiler reared on sawdust at an early age persist at the slaughter age (+4.95%; $p = 0.01$). In contrast, low quality straw resulted in lower ($p = 0.01$) final body weight and feed conversion ratio. On the other hand, pododermatitis lesions appear from the first week in all litter types. The rate of severity of foot pad dermatitis increased significantly with the age of the birds ($p < 0.05$). At the last week, results indicated that the highest rate of chickens with severe lesions (score 4) was recorded in the birds reared on both straw types (60%). In contrast, the lowest rate was found in the group reared on wood shaving (3.3%). However, hock burns and breast blisters were very low ($p > 0.05$). **Conclusion:** It is concluded that the birds reared on sawdust showed the best BW and FCR. However, broilers kept on wood shaving had the best score of plumage and hock burn. The presence of scratches was not observed in any treatment.

Key words: Animal welfare, broiler, growth performance, litter type, pododermatitis

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In broiler production, chickens were usually reared on litter from one day old to slaughter age. They spend most of their life in interaction with the litter material. The litter material must ensure a good in house environment and suitable for the broilers to grow without developing lesions, since it can largely influence on animal welfare, including hock, footpad lesions and breast blister¹⁻³. Furthermore, many studies have shown that litter quality can affect broilers growth performance⁴⁻⁶. On the other hand, litter quality can be affected by many factors, such as the type and amount of litter material, feed composition, litter management techniques, housing type, ambient conditions, drinker management, health status, stocking density and slaughter age^{2,7-10}. Various types of litter materials are worldwide used and many of these are linked to geographical regions. In Algeria, cereal straw is the most common material used as litter in broiler production but this litter type contributing at the degradation of performances, deterioration of broiler quality and emergence

of welfare problems. Therefore, it is important to find an alternative bedding material. For this purpose, the main objective of this study was to evaluate the effects of five litter types (wood shaving, sawdust, standard quality straw, low quality straw and crop residues) on growth performances, carcass defects, carcass condemnation and some welfare parameters in broiler chickens.

MATERIALS AND METHODS

Design and husbandry: Six hundred one-day-old male broiler chicks (Cobb 700) were randomly allocated to five treatments with 6 replicates pens of 20 birds (10 birds/m²). The treatments were consisted of five different bedding types (Fig. 1): wood shaving (WS), sawdust (S), standard quality straw (SQS), low quality straw (LQS) and crop residues (CR). All types of litters were to a depth of approximately 5 cm. Each pen measured 2 m² and was equipped with feeders and nipple drinkers. Feed and water were available ad libitum. Broilers were reared to 42 days of age on a 3 phase commercial feeding program



Fig. 1(a-e):Types of litter used in trial; (a) Low quality straw (LQS), (b) Standard quality straw (SQS), (c) Wood shaving (WS), (d) Crop residues (CR) and (e) Sawdust

consisting of starter (1-15 days), grower (16-30 days) and finisher (31-42 days). All diets were formulated to meet NRC¹¹ recommendation.

Measurements:

- **Growth performance:** Broiler growth performance (body weight, feed consumption and feed conversion) was measured at 07, 10 and 42 days. Mortality was recorded daily
- **Welfare parameters:** Contact dermatitis (pododermatitis, hock buns, breast blister) and plumage cleanliness were measured weekly. The incidence and severity of FPD were measured by the method described by Michel *et al.*¹², a subjective score of 1-5 was used, with 1 representing no lesion and 5 representing depressed lesion. The evaluation was performed on both feet. Hock burns was evaluated according to the method of Bignon *et al.*¹³, there were three scoring categories, as follows: 01 = none lesions, 02 = less than 25% hock area, 03 = more than 50% of the hock area. Score of breast blister and breast burn were based on the presence or absence of scratches and lesions. Feather cleanliness of birds was scored visually from 0 (very clean) to 3 (very dirty) as reported by De Jong *et al.*¹⁴

Statistical analysis: All statistical analyses were analyzed by one-way ANOVA followed by LSD post hoc test using software (SPSS Statistics 22). Differences were considered significant at $p < 0.05$.

RESULTS AND DISCUSSION

- **Growth performance:** Results of body weight (BW), feed intake (FI), feed conversion ratio (FCR) and mortality are shown in Table 1 and 2

Effect of litter type on the growth performance is presented in Table 1 and 2. At the age of one week, it was found that broilers reared on Sawdust gained the highest body weight ($p = 0.015$). The increase in body weights at one week of age was 7.78, 5.38 and 1.79% for group of sawdust, CR and WS, respectively, as compared to their control (Straw). However, birds reared on LQS had significantly ($p < 0.05$) lower body weights than those reared on SQS. The reduction in body weights was 1.79% as compared to their control. Feed intake was statistically similar ($p > 0.05$) on 5 L treatment groups. FCR of birds reared on sawdust was improved compared to those reared on SQS ($p = 0.002$), whereas it was not different in birds reared on WS and CR.

The heavier BW observed in broiler reared on sawdust at an early age persist at the end of the experiment (+4.95%; $p = 0.01$). Also, at the last week, birds reared on LQS showed the poorer FCR compared with other types of litter ($p = 0.013$). While birds reared on sawdust and CR had an equal FCR. Feed intake and percentage of bird's mortality were not affected ($p > 0.05$) by the used litter types.

Several studies have suggested that type of litter would affect growth performance of broilers^{4-6,15}. However, other

Table 1: Effect of litter types on the growth performance at the start period

Parameters	Litter types					p-value
	SQS	LQS	CR	S	WS	
1-7 days						
Body weight (g)	167.00±11	164.00±11	176.00±10	183.00±04	170.00±11	p = 0.015
Feed intake (g)	165.00±17	188.00±19	173.00±16	170.00±14	166.00±17	NS
FCR	0.99±0.09	1.14±0.05	0.98±0.09	0.94±0.04	0.98±0.11	P = 0.002
Mortality (%)	0.83±2.04	4.17±3.76	4.17±5.85	0.00	0.00	NS
1-10 days						
Body weight (g)	237.00±47	228.00±43	252.00±33	261.00±29	247.00±43	NS
Feed intake (g)	281.00±35	320.00±37	303.00±29	302.00±37	297.00±27	NS
FCR	1.21±0.15	1.43±0.11	1.21±0.11	1.16±0.08	1.22±0.16	p = 0.012
Mortality (%)	1.67±2.58	5.00±3.16	5.00±7.75	0.83±2.04	0.83±2.04	NS

Table 2: Effect of litter types on the growth performance at 42 days

Parameters	SQS	LQS	CR	S	WS	p-value
Body weight (g)	2321.00±127	2233.00±36	2376.00±96	2436.00±94	2387.00±91	p = 0.011
Feed intake (g)	3732.00±309	4081.00±351	3881.00±182	3960.00±295	4048.00±333	NS
FCR	1.61±0.10	1.83±0.15	1.63±0.03	1.63±0.13	1.69±0.11	p = 0.013
Mortality (%)	5.00±5.48	7.50±4.18	6.67±7.53	5.00±6.32	9.17±5.85	NS

studies showed that type of litter had no effect on growth performance^{16,17}.

Our study showed that litter type had an impact on growth performance at an early age of the birds. These findings are confirmed by Kheravii *et al.*¹⁵. The effect of litter types on growth performance was also observed at the end of the experiment. Results indicated that, at 6th week, birds reared on sawdust had significantly higher BW, compared to birds reared on straw. These results do not agree with the findings of Grimes *et al.*⁸ and De Avila *et al.*¹⁸ who reported that the body weight was not affected by different bedding types.

Feed consumption was similar in all treatment groups ($p>0.05$). This is in agreement with those reported by El-Sagheer *et al.*¹⁹ However, the feed consumption tended to increase on low quality straw treatment group. These results do not agree with the findings of Hafeez *et al.*¹⁷ who reported that the birds reared on wheat straw consumed less feed quantity compared to other types of litter used.

In this study, FCR of birds was improved by litter type at the start of the rearing period. These results are similar to those reported by Kheravii *et al.*¹⁵ who concluded that FCR of broilers was affected by litter type at the age of 10 days. But in contrast Torok *et al.*²⁰ reported that the types of litter material did not affect feed conversion ratio. The result of the mortality of all litter types used was identical ($p>0.05$). Similar results were reported by Toghyani *et al.*²¹ who concluded that the types of litter did not affect the mortality of birds.

- **Pododermatitis:** The severity scores of FPD are presented in Fig. 2. The lesions of pododermatitis appeared from the first week with low lesions (score 1) in all birds reared on sawdust and wood shaving (100%). While, the birds with moderate lesions (score 2) was found in the group reared on standard quality straw (36.7%), low quality straw (36.7%) and crop residues (43.3%)

As of the second week appear some birds (3.3%) with intermediate lesions (score 3) in group reared on low quality straw was observed. The rate of birds with intermediate lesions (score 3) increase from the fourth week in all the treatment groups but these rate tended to increase more on low quality straw treatment group (75%) followed by the standard quality straw group (66.7%). The rate of severity of FPD increases significantly with the age of the birds ($p<0.05$).

At the last week, results indicated that the highest rate of chickens with severe lesions (score 4) was recorded in the birds reared on low quality straw (60%) and standard quality

straw (60%). In contrast, the lowest rate of birds with severe lesions (score 4) was found in the group of wood shaving (3,3%) and sawdust (6,6%) followed by the Crop residues group (16,7%). However, the total absence of severe lesions (score 5) in all types of litter.

Many scientists have studied the effect of types of bedding materials on severity of FDP in broilers^{2,22-27}. All of them obtained the higher severity of FPD in broilers reared on straw litter comparing with other types of bedding materials. However, in another research, the litter made of wood shavings showed the lower incidence of footpad compared to straw litter^{26,28}. In the present study, the results confirmed previous findings of those authors. Further, broilers reared on chopped straw showed lower rates of FPD compared to broilers raised on un-chopped straw²⁹ and higher than those of the pelleted straw³⁰. In contrast, Kheravii *et al.*¹⁵ reported that the birds reared on pelleted straw showed the lowest incidence of footpad dermatitis compared to those placed on chopped straw and shredded paper. The poor litter quality was reported to be the main factor contributing to the appearance of the lesions on the footpad or hock in broilers³¹. This effect may be associated with the ammonia emission²⁹ and litter moisture²⁵. It means that the severity of FPD increase with higher litter moisture content and lower ammonia emission. Additionally, the lesions of pododermatitis were affected by slaughter age, body weight and housing conditions^{32,33}.

Considering the time of FPD occurrence, our results is close to that obtained by Bilgili *et al.*² and Taira *et al.*²⁵ who reported that the first lesions on footpad might occur earlier in the second week of broiler age. However, the first signs of FPD were observed in the third week of broiler reared on chopped wheat straw and forth week in chickens on pelleted straw²⁷.

- **Contact dermatitis (Hock burns, breast blister) and plumage cleanliness:** In the present study, the breast burn and the hock burn appear at the 5th week of broiler age in all the examined bedding materials. The presence of scratches were not observed in any treatment. The hock burn and the breast burn were not influenced by the litter material ($p>0.05$). However, the appearance of hock burn with severe lesion (score 3) was lower in birds reared on wood shaving (40%) compared to those placed on sawdust (60%), crop residues (61.67%), low quality straw (63.33%) and standard quality straw (73.33%) as shown in Table 3.

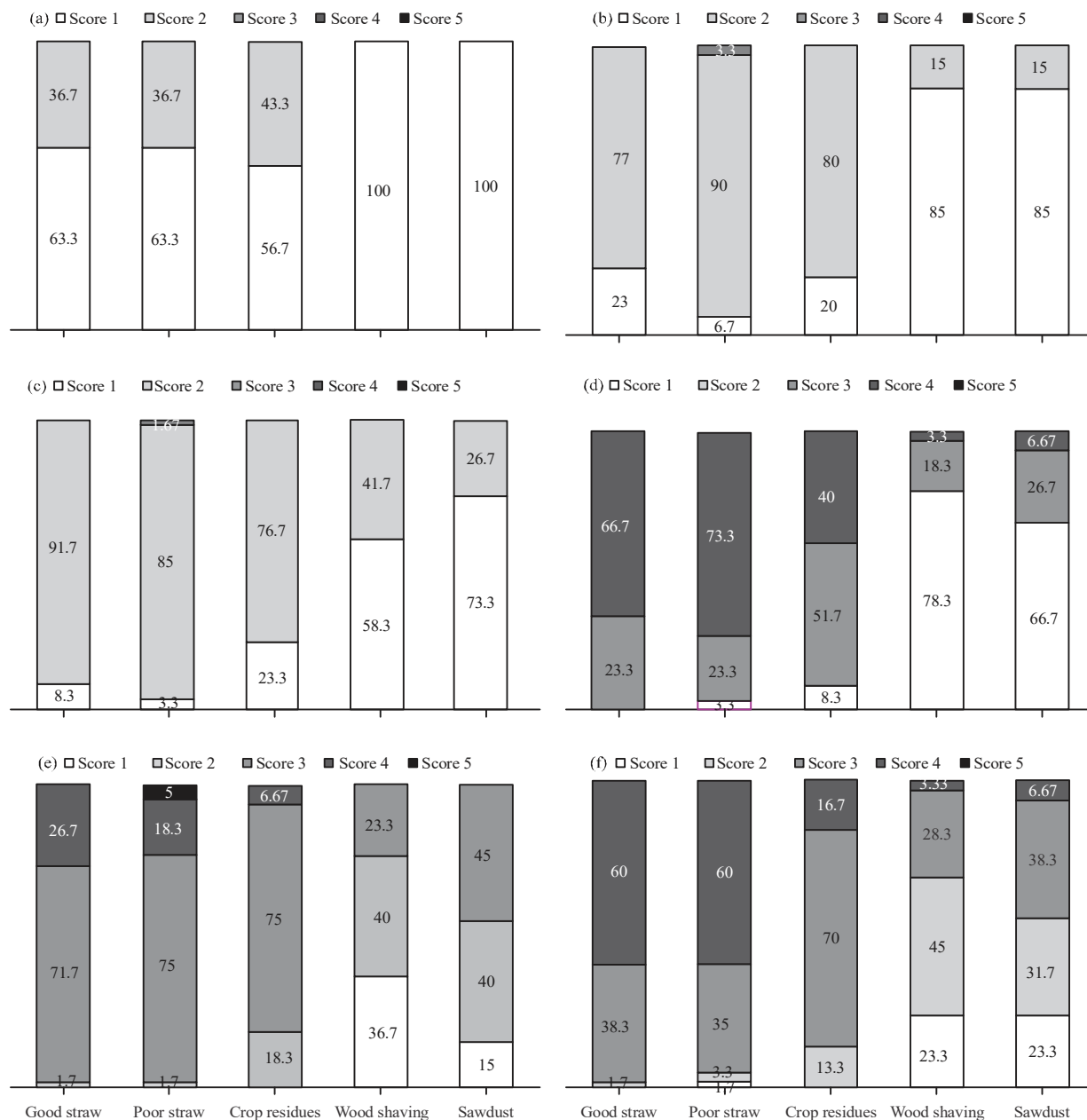


Fig. 2(a-f): Effect of the litter treatment on foot pad dermatitis in broilers; (a) Week 1, (b) Week 2, (c) Week 3, (d) Week 4, (e) Week 5 and (f) Week 6

Table 3: Contact dermatitis and plumage cleanliness

Litter types	Hock burn			Plumage cleanliness			
	1	2	3	0	1	2	3
standard quality straw	0	26.7	73.3	0	0	8.3	91.7
low quality straw	0	36.7	63.3	0	0	5	95
crop residues	0	38.3	61.7	0	0	11.7	88.3
wood shaving	25	35	40	0	0	33.3	66.7
sawdust	0	40	60	0	0	30	70
p-value	NS	NS	NS	NS	NS	p = 0.037	p = 0.037

In broiler production, the pododermatitis, hock burns and breast blister are indicators of housing conditions and the general welfare of the birds. The lesion of FPD is more prevalent than hock burn. The prevalence of breast burn in broiler is very low^{34,35}. Table 3 shows that broilers kept on wood shaving had the best score of plumage and hock burn. This could be related to the litter moisture. Also other factors such as; farm management and housing factors during the rearing period³⁵.

In agreement with the results of the current study, Sorbara *et al.*³⁶ reported that the hock burn and the breast blister are not affected by different bedding types. Moreover, Traldi *et al.*³⁷ observed no differences in breast lesions when compared with the carcass lesions in broilers reared on new or reused litter.

CONCLUSION

In conclusion, litter type had an effect on growth performance of broiler at an early age and at the end of the rearing period. However, birds reared on sawdust showed the best BW and FCR compared with other types of litter. Better score of footpads, hock burns, breast blisters and plumage cleanliness were obtained when wood shaving was used as bedding.

SIGNIFICANCE STATEMENT

This study discovered the effect of litter types that have not been studied before in the East of Algeria, a region where there is the highest density of broiler production. This study proposed an alternative for litter material usually used in this country to improve the growth performance and the welfare of broilers.

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