Impact of different litter materials on behaviour and performance of broilers

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Summary

This work was conducted to study the effect of different types of litter material on the productive performance and some behaviours of commercial broiler chickens. In this study, 250 – day-old broiler (Lohman strain) chicks were obtained from a commercial hatchery and divided into five nearly equal weights groups (50 each). The chicks were conventionally brooded for 7 weeks in environmental controlled rooms (0.14 m²/ bird). Each of five cement-floored rooms was bedded using deep litter system with 8 cm of litter material {chopped wheat straw (WS), chopped rice straw (RS), 70% chopped rice straw mixed with 30% wood shaving (RSws), wood shaving (WSh) and sand (S)}. Suitable commercial diet and drinking water were provided adlibitum using commercially available plastic circular feeders and drinkers along the experiment.

There were no significant differences in feed consumption, body gain and feed conversion between broilers reared on different types of litter materials. While the highest litter pH and moisture were recorded in wood shaving and the lowest ones were recorded in sand when used as litter material. Total bacterial count, total fungal count and coccideal oocyst were higher in wood shaving litter material than those in chopped wheat straw, chopped rice straw, 70% chopped rice straw mixed with 30% wood shaving, and sand.

No cases of blindness, ocular discharge and cannibalism were observed in birds of all groups while leg and feet disorders were recorded only in birds kept on wheat straw and wood shaving. But, breast blisters were observed in birds reared on rice straw and wheat straw (8 and 10 cases, respectively). The highest mortality percent was recorded among birds reared on wood shaving followed by sand, rice straw, rice straw mixed with wood shaving and wheat straw. Rest and dust bathing behaviours were increased in birds kept on rice straw and sand while, ground pecking was increased in birds reared on sand and wood shaving.

In conclusion, pure wood shaving, rice straw and sand shouldn’t use as litter materials while rice straw mixed with wood shaving can be used as a substitution litter material to chopped wheat straw for rearing broilers to achieve better performance and comfortable conditions.

Keywords: Broiler behaviour, Litter materials
Introduction

Quality of chicks, feed and water are all of great concern to broiler producer. But the type and quality of litter in broiler houses are seldom given sufficient emphasis. Broilers don’t perform to their genetic potential in a poor environment. The quality of the in-house environment is highly dependent up on litter quality and the litter environment is ideal for bacterial proliferation and ammonia production. This is unfortunate because birds are in continuous contact with litter. A wide variety of litter materials have been considered for raising broilers such as; saw dust, wheat straw, sand, rice husk, sugar cane pulp, oat hulls, corncobs, paper chips and peat moss (Swain and Sundaram, 2000).

The ideal litter should be economical, durable, contain little moisture and shouldn’t be readily caked (North, 1981). The type of litter and their depth had no significant effect on broiler live body weight, weight gain, feed consumption and food conversion ratio (Thomas et al., 2001), while the survivability was influenced by the type of litter and tended to increase on saw dust. The highest moisture content of used litter was found in sawdust litter followed by rice husk and wheat straw (Monir et al., 2003).

The concentrations of ammonia in rooms with wood shaving or sand were generally lower than chopped straw (AL-Homidan and Robertson, 2003). However, Lindner (1998) recorded that the wood shaving deep litter showed higher concentrations of ammonia in house than chopped straw. Remembering that, chickens are sensitive to ammonia as prolonged exposure to high levels (50 to 100 ppm) can result in blind birds and the production is seriously affected. However, ammonia at level of 25 ppm has been found to depress growth and feed conversion in broiler in addition, a great incidence of air sacculitis. The serum total protein, calcium and phosphorus concentrations didn’t differ among the chicks belonging to different litter types (Swain et al., 2001) and the mortality percent of broiler kept on 100% saw dust, 70% saw dust and 30% peat and 100% straw cuts was 2.2, 3.3 and 3.3%, respectively (Sosnowka and Herbut, 2000).
Rest, dust bathing and food searching behaviours were higher in broilers kept on wood shaving litter than those kept on straw. While, feed intake and comfort behaviour were increased in broilers reared on straw litter than those reared on wood shaving (Lindner, 1998). In spite, broiler spent a greater property of their time in the form of dust bathing on sand as a litter material than on paper or wood shaving but there was no dust baths on the rice hulls. Ground pecking behaviour generally precedes a dust-bathing bout and the rate of pecking and its proportion of the total time spent were also highest for sand litter (Shields et al., 2004).

Pine shaving had less moisture, less bulk density and more moisture absorbing capacity than hard wood bark. Also, if the litter is too dry and dusty can also lead to problems such as; dehydration of new chicks and respiratory diseased so the ideally litter moisture should be maintained at 20 to 25 %. No significant differences in either pH or nitrogen content were found in the litter types during the grow out period (Brake et al., 1992). Meanwhile, Bilgili et al. (2003) reported that, 80% of birds reared on long straw showed various leg and feet lesions but only 20% of those reared on chopped straw developed lesions. The litter cake (spoiling) score is more in long straw than chopped one and high litter cake score are generally followed by a high incidence and severity of foot lesions (Kuczynski et al., 2002).

The present work was therefore undertaken to study the effect of different types of litter material on the productive performance and behaviour of commercial broiler chickens and also as a trial to utilize rice straw that considered as an environmental pollutant.

**Materials and Methods**

Two hundred and fifty day-old broiler (Lohman strain) chicks were obtained from a commercial hatchery and divided into five nearly equal weights (49.5±1) groups (50 each), which reared in environmental controlled rooms (0.14 m²/bird) at one day of age. Each of five cement-floored rooms was bedded using deep litter system with 8 cm of litter material {chopped wheat straw (WS), chopped rice straw (RS), 70% chopped rice straw mixed with 30% wood shaving (RSws), wood shaving (WSh) and
sand (S)). Suitable commercial diet and drinking water were provided ad libitum using commercially available plastic circular feeders and drinkers along the experiment using Cairo Company feed formula according to the stage of growth.

An electric heater was used in each room to adjust the room temperature at 30 to 33°C during the first week, 27 to 30°C during the second week, 24 to 27°C during the third week 21 to 24°C during the fourth week and the temperature was maintained at 18 to 21°C up to 50 days. An exhausted fan in each room when needed provided the ventilation. The experiment was conducted from January 18 to March 10, 2005 in a private poultry farm at Menoufia Governorate. All birds were immunized against Newcastle disease (Intervet company) as the procedure recommended by the vaccine producer.

**Measurements:**

1- Feed consumption.
2- Body weight
3- Body weight gain.
4- Feed conversion ratio.
5- Mortality percent.
6- Litter microbiology: Total bacterial and fungal (yeasts and molds) count were determined according to APHA (1992) and Latala et al. (1999) in the litter samples which collected from three different locations (near the feeders, drinkers and walls) of each room weekly by taking 1 kg from each site then mix it well to represent the sample of wanted room.

7- Litter moisture was estimated by reweighing a 2 kg of litter sample from each room after drying for 72 hours at 90°C in an electric oven according to Lien et al. (1998).

8- Litter pH was determined according to Lien et al. (1998) by placing a 300 g of litter sample from each room in 2700 mL of distilled water and shaking well for 30 seconds. After allowing this suspension to settle for one minute the pH of the supernatant was determined using pH paper graduated into 0.2 degree.

9- Litter parasitology: Eimeria oocyste was determined in litter according to Linden et al. (2000).
10-Air samples were taken to estimate the environmental ammonia concentration by filling a litter capacity flask with warm water then evacuated within another container inside each room to be replaced by air of house then closed probably and evaluated for ammonia according to A. O. A. C. (1975).

11-Some bird health problems as; leg or feet disorders (lameness, foot ball, foot pad dermatitis and abscessiation), ocular discharge, blindness, breast blisters (inflamed defeathered area at breast region), cannibalism and mortality percent were recorded.

12-Some bird behaviours as; rest, dust bathing and ground pecking were recorded. Four focal birds from each group were marked on their back with a non-toxic blue colour and taken as a sample for behavioural observations. Each observation occurred for one hour/ week/ each group using video camera during daylight and these observations began approximately four hours after the lights came on as close to the peak of dust bathing hours according to Statkiewicz and Schein (1980).

Statistical Analysis: Data were collected, arranged, summarized and analyzed using the general Linear model procedures of the SAS, Institute INC (1985). Results were recorded in tables (1 to 4).

Results and Discussion

Table (1) shows that, there were no significant differences in feed consumption, body gain and feed conversion between broilers reared on different types of litter materials. These results agree with that recorded by Malakar et al. (2002) who noticed that the type of litter had no significant effect on broiler live body weight, weight gain, feed consumption and food conversion ratio.

The highest litter pH (9.2) was recorded in wood shaving litter material and the lowest one (5.8) was recorded in sand when used as litter material. There was a significant differences in litter moisture contents as; the litter moisture contents were 35, 33, 31, 38, and 22% for wheat straw, rice straw, rice straw mixed with wood shaving, wood shaving and sand, respectively. The environmental ammonia content
was greater in the house bedded with wood shaving followed by rice straw, rice straw mixed with wood shaving, wheat straw and sand as shown in table (1). These differences may be due to the more limited ability of ammonia producing bacteria to use wood shaving as a substrate for growth due to their greater lignin content (Duqueza, 1996) as well as, high moisture and bacterial population content.

The variations in bacterial population were noted between different types of litter as; the highest total bacterial count (3.6 X 10^8 c.f.u./g) was recorded in wood shaving followed by rice straw (1.6 X 10^8 c.f.u./g), rice straw mixed with wood shaving (4.9 X 10^6 c.f.u./g), wheat straw (2.8 X 10^6 c.f.u./g) and sand (1.4 X 10^6 c.f.u./g) as shown in table (2). As well as, the total fungal count and the number of coccidial oocyst were higher in wood shaving and wheat straw than rice straw, rice straw mixed with wood shaving and sand. This may be attributed to that wet litter further aggravates coccidiosis by providing the proper environment for oocysts to sporulate, thereby increasing challenge levels to which birds are exposed. These results disagree with that reported by Lien et al. (1998) who recorded that the population of aerobic, psychrotrophic and coliform bacteria and fungi (yeast and molds) were not influenced by litter types.

Leg and feet disorders were recorded only in birds kept on wheat straw and wood shaving as a litter material. While, no cases of blindness or ocular discharge were observed in birds reared on different types of litter materials. This may be attributed to good stocking density and ventilation in these houses. In spit, the birds kept on rice straw and wood shaving showed 8 and 10 cases of breast blister, respectively (table, 3). This may be due to the inactive birds spend most of their time with their shanks or breasts in contact with the litter and if it was wet it can lead to breast blisters or hock burn and foot pad dermatitis. These results agree with that recorded by Kuczynski et al. (2002).

No cases of cannibalism were recorded among the birds kept on different types of litter materials (table 3), as the predisposing factors for feather pecking (Dietary changes, low ambient temperature, high light levels and absence of loose litter at the end of grow out period) were not present (Green et al., 2000). But the mortality percent was differ among the birds as; the highest percent of mortality was recorded
in birds reared on wood shaving followed by sand, rice straw, rice straw mixed with wood shaving and wheat straw.

Data present in table (4) demonstrates that, rest and dust bathing behaviour were increased in birds reared on rice straw and sand while the ground pecking was increased in birds kept on sand and wood shaving as a litter material. These results agree with that observed by (Shields et al., 2004) Who mentioned that the birds readily dust bathing in wood shaving or other floor litter but, if finer material such as sand or peat is available, they probably prefer it because finer materials are superior at penetrating the feathers to reach the downy portion of plumage.

In conclusion, pure rice straw or rice straw mixed with wood shaving can be used as a substitution litter material to wheat straw for rearing broilers to achieve better performance and comfortable conditions.
Table (1): Effect of different types of litter material on broilers performance and some litter traits.

<table>
<thead>
<tr>
<th>Items</th>
<th>WS</th>
<th>RS</th>
<th>RSws</th>
<th>WSh</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
</tr>
<tr>
<td>WT. Of chick at day old (g)</td>
<td>49±0.041a</td>
<td>50±0.040a</td>
<td>49±0.038a</td>
<td>48.9±0.042a</td>
<td>50.5±0.040a</td>
</tr>
<tr>
<td>WT. Of chick 50 days old (g)</td>
<td>1750±0.022a</td>
<td>1740±0.019a</td>
<td>1730±0.018a</td>
<td>1760±0.018a</td>
<td>1750±0.017a</td>
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<tr>
<td>Body Wt. Gain (g)</td>
<td>1701±0.004a</td>
<td>1690±0.006a</td>
<td>1681±0.005a</td>
<td>1711.1±0.003a</td>
<td>1699.5±0.006a</td>
</tr>
<tr>
<td>Feed consumption (g)</td>
<td>4100±0.068a</td>
<td>4060±0.064a</td>
<td>4150±0.070a</td>
<td>4090±0.066a</td>
<td>4130±0.069a</td>
</tr>
<tr>
<td>Feed conversion (g food/g gain)</td>
<td>2.41±0.005a</td>
<td>2.40±0.002a</td>
<td>2.46±0.006a</td>
<td>2.39±0.014a</td>
<td>2.43±0.010a</td>
</tr>
<tr>
<td>Litter pH</td>
<td>6.2±0.012a</td>
<td>8.6±0.021b</td>
<td>8.4±0.042b</td>
<td>9.2±0.031c</td>
<td>5.8±0.061d</td>
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<tr>
<td>Litter moisture (%)</td>
<td>35±0.023a</td>
<td>33±0.045b</td>
<td>31±0.002c</td>
<td>38±0.012d</td>
<td>22±0.010e</td>
</tr>
<tr>
<td>Environmental ammonia (p.p.m.)</td>
<td>14±0.001a</td>
<td>18±0.022b</td>
<td>16±0.003c</td>
<td>29±0.023d</td>
<td>12±0.011e</td>
</tr>
</tbody>
</table>

*Mean which subscript with different small letters at the same row (a, b, c, ...) differ significantly at (P<0.05).

Table (2): Parasitology and microbiology of different types of litter material.

<table>
<thead>
<tr>
<th>Items</th>
<th>WS</th>
<th>RS</th>
<th>RSws</th>
<th>WSh</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
<td>Mean ±SE</td>
</tr>
<tr>
<td>Total bacterial count (c.f.u./g)</td>
<td>2.8 x10^6±0.012 a</td>
<td>1.6 x10^6±0.023 b</td>
<td>4.9 x10^6±0.002 c</td>
<td>3.6 x10^6±0.041 d</td>
<td>1.4 x10^6±0.005 e</td>
</tr>
<tr>
<td>Total fungal count (c.f.u./g)</td>
<td>1.8 x10^8±0.007 a</td>
<td>2.2 x10^8±0.036 b</td>
<td>3.5 x10^6±0.001 c</td>
<td>4.4 x10^6±0.011 d</td>
<td>3.1 x10^6±0.021 e</td>
</tr>
<tr>
<td>Coccidial oocyst (oocyste/g)</td>
<td>12±0.025 a</td>
<td>8±0.006 b</td>
<td>5±0.052 c</td>
<td>14±0.009 d</td>
<td>4±0.004 e</td>
</tr>
</tbody>
</table>

*Mean which subscript with different small letters at the same row (a, b, c, ...) differ significantly at (P<0.05).
Table (3): Effect of different types of litter material on broilers health.

<table>
<thead>
<tr>
<th>Items</th>
<th>WS</th>
<th>RS</th>
<th>RSws</th>
<th>WSh</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg disorders (case)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Blindness (case)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Ocular discharge (case)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Breast blisters (case)</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Cannibalism (case)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mortality %</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Table (4): Effect of different types of litter material on some broiler behaviours.

<table>
<thead>
<tr>
<th>Items</th>
<th>WS</th>
<th>RS</th>
<th>RSws</th>
<th>WSh</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest period (hour)</td>
<td>1.5</td>
<td>2.5</td>
<td>1.5</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Dust bathing (times)</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Ground pecking (minutes)</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>
References


