Evaluation of Different Litter Materials for Broiler Performance, Coccidial Oocyst Population and Level of N, P and K During Winter

Biswa S.K., M. A. Wahid, M. J. Karim, M. A. H. Pramanik and M. Rokonuzzaman
Department of Poultry Science, Department of Parasitology, Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract: The two commonly used litter materials in Bangladesh, wheat straw and sugarcane bagasse, were examined for their suitability in broiler rearing. Chicks reared on wheat straw had a significantly higher (P < 0.01) feed conversion ratio compared with others. Coccidial oocysts counts per gram of litter reached a peak at 5th week, and except a significantly higher (P < 0.01) count in sawdust litter at 4th week the counts were not different between the groups. The birds were apparently healthy and did not have any physical abnormalities. Nitrogen content of different used litter did not vary significantly (P > 0.05) but the potassium and phosphorus contents in wheat straw were significantly higher (P < 0.01) as compared with other litters. Considering the broiler performance sawdust was found to be the best litter, although wheat straw had a better manure value but with poor broiler performance. Therefore it is suggested that during winter sawdust litter may be used for broiler rearing in Bangladesh.

Key words: Litter, broiler performance, coccidial oocysts and manure value

Introduction
Litter provides a comfortable environment in floor pen rearing of chicks. Different litter materials like chopped straw, rice husk, sugarcane pulp, oat hulls, corn cobs, ground corn cobs, paper mill by-products, sawdust, wood shavings, sand, peat moss etc. have been investigated as to their suitability in broiler rearing in different parts of the world (Oliveira et al., 1975; Ranade and Rajmane, 1990). The importance of a good quality litter for floor-reared birds is well recognized, although the performance is unlikely to be severely affected by the type of litters (Brake et al., 1993; Al Hamdan et al., 1997). Moisture content in the litter affects the sporulation and viability of coccidial oocysts (Tomhave, 1949) and therefore it is an important factor in the development of Eimeria infections. Davies and Joyce (1986) reported that the number of litter oocysts in commercial poultry houses is correlated with moisture in the litter. Used litter is a good source of manure for crop production; it provides important essential nutrient elements required by the plant (Rao, 1988). Rice husk and sawdust are the two most commonly used litter materials for broiler rearing in Bangladesh. Although wheat straw and sugarcane bagasse are easily available in Bangladesh, these are not usually used as litter materials in broiler rearing. The cost of these litters mainly depends on their quality and availability, which cost lower in price and are cheaper in comparison with other litter. The present study was therefore undertaken to investigate the performance of broilers and coccidial oocyst population in different litters, and the manure (NPK) value of these used litters during winter.

Materials and Methods
Chicks and maintenance: The experiment was carried out at Bangladesh Agricultural University Poultry Farm, Mymensingh for a period of 42 days from 23rd December 1999 to 3rd February 2000. One hundred and sixty eight, seven-days-old Arber Acres chicks divided into four groups were reared on four different types of fresh litter materials (rice husk, sawdust, wheat straw and sugarcane bagasse) at the depth of 6cm. Each group was divided into four subgroups. The pans were cleaned and disinfected with Potassium Permanganate solution. The chicks were given a broiler starter ration for 7 to 28 days and finisher ration for 29 to 49 days and water ad

ullitum. Birds were provided with a temperature of 32°C at second week of age, then reduced gradually at the rate of 2.7°C per week up to 7th week. Chicks were vaccinated against Newcastle infectious bronchitis and bursal disease as per recommendation of the manufacturer. For coccidiosis control, DOT (T-652, Dinitro-O-Toluidine) was added to feed at the rate of 0.05kg/100kg feed till the end of the experiment.

Sampling of litter: Litter samples were collected every week from four corners and a central position of each of the pans and then were mixed thoroughly. Half of the samples were used for counting coccidial oocysts and the remaining half was further processed for determination of nitrogen (N), potassium (K) and phosphorus (P).

Litter oocysts count: The number of coccidial oocysts per gram of litter was counted, following the method of Karim et al. (1994). Ten grams of litter were soaked in 100ml of water for 24 hours and mixed thoroughly by vigorous shaking in a screw capped bottle and subsequently sieved through a tea strainer to remove the coarse particles. After centrifugation at 1100g for five minutes, supernatant was discarded, the sediment was re-suspended in 100ml of saturated salt solution. Two chambers of McMaster counting slide were filled with the suspension using a plastic transfer pipette and allowed 3 to 5 minutes for floatation of the oocysts before examination. The number of oocysts was counted using a X 6-eye piece and X 10 objective of a compound microscope.

Determination of N, P and K: Nitrogen content was estimated by Kjeldahl method (Banerjee, 1978). For determination of phosphorus and potassium contents, extract was prepared by taking 1g of used litter with 10ml D-acid mixture heated at 180°C temperature for half an hour and filtering after cooling and making volume of the filtrate up to 100ml with distilled water. The phosphorus content was determined spectrophotometrically from the prepared extract by developing blue colour of phosphomolybdate complex as described by Jackson (1973). Potassium content of used litter materials was determined with the hope of flame emission spectrophotometer (Jackson, 1973).
Table 1: Performance of broilers (7 to 49 days of age) reared on different types of litter materials

<table>
<thead>
<tr>
<th>Variables</th>
<th>Types of litter</th>
<th>Rice husk</th>
<th>Saw dust</th>
<th>Wheat straw</th>
<th>Sugarcane bagasse</th>
<th>SED of means</th>
<th>Statistical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight (g/bird)</td>
<td></td>
<td>144.23±4.89</td>
<td>149.26±19.83</td>
<td>142.69±8.52</td>
<td>147.96±37.85</td>
<td>23.45±4.89</td>
<td>NS</td>
</tr>
<tr>
<td>Feed consumption (g/bird)</td>
<td></td>
<td>3337±21</td>
<td>3402±78</td>
<td>3462±11</td>
<td>3387±38</td>
<td>76.60±24</td>
<td>NS</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td></td>
<td>2.45±4.31</td>
<td>2.41±6.97</td>
<td>2.58±24.2</td>
<td>2.43±10.57</td>
<td>0.04±0.06</td>
<td>**</td>
</tr>
<tr>
<td>(FCR) (g food/g gain)</td>
<td></td>
<td>0.06±1.24</td>
<td>0.06±7.62</td>
<td>0.01±9.72</td>
<td>0.01±10.00</td>
<td>2.01±2.01</td>
<td>NS</td>
</tr>
<tr>
<td>Survivability (%)</td>
<td></td>
<td>95.24±6.12</td>
<td>97.62±4.12</td>
<td>97.62±4.12</td>
<td>100.00±0.00</td>
<td>0.0±0.00</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Values with different superscripts in the same row are significantly different.
**Significant (P<0.01), NS insignificant (P>0.05) and values indicate mean ± SD

Table 2: Coccidial oocyst population (x10³) in different types of litter materials

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Types of litter</th>
<th>Rice husk</th>
<th>Saw dust</th>
<th>Wheat straw</th>
<th>Sugarcane bagasse</th>
<th>SED of means</th>
<th>Statistical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td></td>
<td>0.02±0.02</td>
<td>0.03±0.04</td>
<td>0.03±0.00</td>
<td>0.04±0.02</td>
<td>0.02±0.06</td>
<td>NS</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td>0.20±0.07</td>
<td>0.17±0.06</td>
<td>0.17±0.11</td>
<td>0.19±0.07</td>
<td>0.06±0.03</td>
<td>NS</td>
</tr>
<tr>
<td>4th</td>
<td></td>
<td>1.23±0.23</td>
<td>1.76±0.17</td>
<td>1.03±0.29</td>
<td>1.13±0.18</td>
<td>0.01±0.01</td>
<td>**</td>
</tr>
<tr>
<td>6th</td>
<td></td>
<td>2.97±0.47</td>
<td>3.00±0.42</td>
<td>2.77±0.36</td>
<td>2.45±0.24</td>
<td>0.32±0.03</td>
<td>NS</td>
</tr>
<tr>
<td>8th</td>
<td></td>
<td>0.87±0.34</td>
<td>0.64±0.14</td>
<td>0.71±0.14</td>
<td>0.74±0.24</td>
<td>0.19±0.03</td>
<td>NS</td>
</tr>
<tr>
<td>10th</td>
<td></td>
<td>0.33±0.07</td>
<td>0.46±0.12</td>
<td>0.32±0.07</td>
<td>0.35±0.08</td>
<td>0.06±0.08</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Values with different superscripts in the same row are significantly different.
**Significant (P<0.01), NS insignificant (P>0.05) and values indicate mean ± SD

Table 3: Manure values (N, P, K) of different litters used

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Types of litter</th>
<th>Rice husk</th>
<th>Saw dust</th>
<th>Wheat straw</th>
<th>Sugarcane bagasse</th>
<th>SED of means</th>
<th>Statistical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N) Content (%)</td>
<td></td>
<td>3.46±0.1</td>
<td>3.46±0.1</td>
<td>3.44±0.1</td>
<td>3.41±0.9</td>
<td>0.04±0.1</td>
<td>NS</td>
</tr>
<tr>
<td>Phosphorus (P) Content (%)</td>
<td></td>
<td>0.85±0.00</td>
<td>0.91±0.1</td>
<td>1.15±0.1</td>
<td>1.16±0.1</td>
<td>0.07±0.1</td>
<td>**</td>
</tr>
<tr>
<td>Potassium (K) content (%)</td>
<td></td>
<td>0.11±0.00</td>
<td>0.12±0.00</td>
<td>0.16±0.00</td>
<td>0.11±0.1</td>
<td>0.06±0.1</td>
<td>**</td>
</tr>
</tbody>
</table>

*Values with different superscripts in the same row are significantly different.
**Significant (P<0.01), NS insignificant (P>0.05) and values indicate mean ± SD

Record on weight gain and feed consumption: The chicks were weighed individually at the end of each week and averaged. A definite quantity of feed was given everyday and the unutilized feeds were weighed to calculate the actual feed consumption. FCR was then calculated by the formula:

\[ FCR = \frac{\text{feed consumption}}{\text{body weight gain}} \]

Statistical analysis: The principles of experimental design were in accordance with Steel and Torrie (1980). Completely Randomized Design (CRD) was applied for statistical analysis of data collected for different variables. Significant differences between means were separated by Least Significant Difference (LSD).

Results: The details on production performance of broiler chicks reared on four different types of litter materials are shown in Table 1. Although there were apparent differences in live weight and feed consumption among different groups, these were not significantly (P>0.05) different. However, the FCR in chicks reared on wheat straw was significantly higher (P<0.01) as compared with all other groups, which were not different between them. The results of litter oocyst counts are shown in Table 2. Very few oocysts were detected in all samples collected at second week. Then the numbers of oocysts were gradually increased and reached a peak at 6th week, then gradually declined. The mean oocyst counts in different litters were not significantly (P>0.05) different except at 4th week when sawdust litter contains significantly higher (P<0.01) oocysts as compared with three other litters. However in all cases the number of oocysts in litter remained lower and was not enough to produce clinical coccidiosis. The chicks also had no leg abnormalities or breast blister during the experimental period. The details on nitrogen, phosphorus and potassium content of different used litter have been shown in Table 3. Nitrogen content in different used litters did not vary significantly (P>0.05). But both the phosphorus and potassium contents in wheat straw were significantly higher (P<0.01) as compared with all other litters.

Discussion: The performance of broilers reared on different conventional litter materials is unlikely to differ significantly. Lack of difference in live weight gain of broilers reared on different
litter materials was not unexpected. This is in agreement with the findings of Anisuzzaman and Chowdhury (1996) and Oliveira et al. (1975). Similarly lack of significant difference in feed consumption among the different groups is in agreement with the findings of Martinez and Garnat (1996) and Lien et al. (1992). Lack of significant difference in FCR of chicks reared on rice husk, sawdust and sugarcane bagasse is contradictory with the findings of Anisuzzaman and Chowdhury (1996), who reported that FCR value on rice husk was higher than those on sawdust, chopped straw and sand in a study conducted during summer. Absence of leg abnormalities and breast blisters in chicks is in agreement with the findings of Haque and Chowdhury (1994). This suggests that types of litter had no direct effect on the physical health of the birds. The number of oocysts per gram of litter from different groups was generally lower than the figures reported earlier by Mizu et al. (1998). The pattern of oocysts in chickens at different stages is in agreement with the results of Karim et al. (1994) and Mizu et al. (1998). Despite vigorous cleaning there has always been few residual oocysts on the floor to initiate the infection. In the absence of coccidial challenge, the residual oocysts after recycling can lead to clinical coccidiosis with eventual mortality. The chemophylactic regime using DOT in the feed successfully controlled the occurrence of coccidiosis. However the small number of oocysts detected in all groups was due to leakage. Even with the best anticoagulant drug a proportion of the concentrate managed to complete the life cycle. Similar result was also reported by Mizu et al. (1998) from their winter study and Haque and Chowdhury (1994) from their summer study. Significantly higher phosphorus and potassium content in used wheat straw litter is in agreement with the findings of Allison and Anderson (1970), who found that wheat straw contained more P₂O₅ and K₂O than sawdust. The significantly higher phosphorus and potassium content might be due to a relatively higher fermentation and decomposition rate of wheat straw, which is responsible for higher rate of absorption of phosphorus and potassium from broiler droppings. Considering the production performances, especially the FCR value, rice husk, sawdust and sugarcane bagasse are better than wheat straw. On the other hand considering the manure value wheat straw was the best, but the over all performance was poor. Sawdust is the cheapest compared with other litters. Utilization of used poultry litter for increasing the fertility of soil for crop production will be an excellent idea. This will also minimize the environmental hazards created by dumping of litters here and there. But before recommending the wide scale use of the used litter it is necessary to examine the possibility of any negative effect on soil fertility. After careful investigation, wheat straw litter proves to be beneficial in crop production compared with other used litters. It can be recommended as the litter of choice for broiler production. But before that it is suggested that during winter sawdust litter may be used for broiler rearing in Bangladesh.

Acknowledgments
The authors would like thank to Professor Dr. S. Ahmed, Director, Poultry Development Project, Department of Poultry Science for his interest and making birds and feed available to the authors for this study.

References