Composting of Poultry Carcass with Farm Yard Manure in Summer

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Abstract: Aerobic composting experiment was carried out to study the feasibility of composting dead birds with farm yard manure (FYM) co-composted with paddy straw or sorghum hay as carbonaceous material. Two treatment mixtures were formulated viz., T1 (dead birds+ FYM + straw) and T2 (dead birds +FYM+ sorghum hay) and T3 (FYM alone) as control in ratio to adjust C:N as 20:1 and moisture level as 60 per cent. Composting work was carried out during summer with one replicate. The dead birds were sequentially layered as per recipe and physical, chemical and microbial changes during composting were recorded. T1 and T2 reached the peak temperature by second week, peak temperature of 66.69°C (T1) and 69.10°C (T2) was significantly (P<0.01) higher than control (51.82°C). The thermophilic temperature persistency was more in treatment mixture 54 days and 65 days respectively for T1 and T2. The total composting period was significantly high for T1 (127.5 days) followed by T2 (166.5 days) and least for control (107 days). Weight and volume reduction was significantly higher in treatment group than control. pH and EC was within acceptable range. Total nitrogen content was significantly higher in T1 (13.771 g/kg) and T2 (12.75 g/kg) than control group (9.967 g/kg). C:N ratio in the finished compost was below 20:1 and the K level of treatment group was significantly higher than control group. The compost mixtures ensure biosafety by way of reduction in the indicator organisms viz., coliform and salmonella.

Key words: Dead bird compost, waste disposal, carcass compost, dead bird disposal, aerobic composting

INTRODUCTION

Poultry is one of the fastest growing segments of the agricultural sector in India. While the production of agricultural crops has been growing at a rate of 1.5 to 2 per cent per annum, eggs and chicken meat production has been growing at a rate of 8 to 10 per cent per annum[1]. Reason behind this tremendous growth is mainly industrialization of poultry rearing.

Presently commercial poultry rearing is concentrated mainly to certain pockets results in more number of birds housed relatively in smaller area. Death of commercial poultry due to natural cause and due to bacterial or viral diseases is not uncommon. Nearly 7 to 11 per cent stock die due to various reasons before they complete their laying cycle[1]. Safe disposal of these dead birds is a major problem to the poultry growers. Various methods like incineration, burial and anaerobic digestion, rendering are employed in disposal of dead birds but they are costlier and labour intensive. An alternative to this method is disposal of dead birds by aerobic composting.

Composting is a controlled natural process in which beneficial microorganisms (bacterial and fungi) reduce and transform organic waste into a useful end product called compost[2]. Composting of livestock and poultry manure[3-4] and municipal solid waste[5] is recommended as an eco-friendly process with less cost and labour. Hence an attempt was made to compost the dead birds along with farm yard manure (FYM).

MATERIALS AND METHODS

The composting experiment was carried out Veterinary College and Research Institute, Namakkal, Tamil Nadu, India located at 11° 09'42.1" N latitude and 78°09'39.7" E longitude at an altitude of 192 meters above mean sea level (MSL). The soil type is non-calcareous red and brown soil and calcareous black soil. The climate ranges from semi arid to sub-humid with frequent occurrence of drought. The meteorological variables recorded during the composting period were given in the table1.

Aerobic composting was done in mini composter specially designed with a specification of 1.2 m length x 1.2m width x 1.2m height[6]. The floor of the compost bin was made up of concrete slabs and the side walls of the
Composting was carried out during the period between March and June 2005. The compost bins were filled as per recommendation of Donald et al.\textsuperscript{[9]} and USDA-NRCS\textsuperscript{[10]} by sequential layering of carcass, manure substrate and carbon source with addition of moisture. The compost bins were opened when the bin temperature was below 40°C (primary stage) and the content was mixed thoroughly, remoistened and aerated and filled again for secondary stage heating. When the second heating cycle was completed, the compost materials were moved to a storage yard.

The temperature of the compost bins were recorded with the help of compost thermometer (\textit{WIKA} make model name \textit{TREND}). Moisture content of composting samples was determined by drying at 105°C in the hot air oven for 24 hours\textsuperscript{[10-12]}. pH, electrical conductivity (EC) and total dissolved salts (TDS) were measured\textsuperscript{[10]} using digital pH meter (\textit{Water proof pH, EC/TDS and Temperature meter, HANNA Instruments, model No. HI 98130}) by preparing 1: 10 w/v compost – water extract.

Table 1: Mean ± SE of meteorological variable during the composting period.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Maximum temperature (°C)</td>
<td>35.97±0.19</td>
<td>35.23±0.28</td>
<td>35.71±0.28</td>
<td>34.50±0.22</td>
</tr>
<tr>
<td>Minimum temperature (°C)</td>
<td>23.35±0.25</td>
<td>24.97±0.23</td>
<td>25.29±0.17</td>
<td>25.30±0.17</td>
</tr>
<tr>
<td>Relative humidity at 8.00 hrs (per cent)</td>
<td>77.42</td>
<td>77.97</td>
<td>77.74</td>
<td>80.03</td>
</tr>
<tr>
<td>Relative humidity at 2.00 hrs (per cent)</td>
<td>40.00</td>
<td>52.17</td>
<td>49.65</td>
<td>54.73</td>
</tr>
<tr>
<td>Wind speed (Km/hr)</td>
<td>4.87</td>
<td>4.38</td>
<td>4.15</td>
<td>8.67</td>
</tr>
<tr>
<td>Rainfall days</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2: Mean ± SE of physical properties and chemical composition of different ingredients used in formulation of compost recipe.

<table>
<thead>
<tr>
<th>Type of ingredient</th>
<th>pH</th>
<th>Moisture (%)</th>
<th>Electrical conductivity (mS/cm)</th>
<th>Total dissolved salts (ppm)</th>
<th>Total nitrogen (g/kg)</th>
<th>Total phosphorus (g/kg)</th>
<th>Total Calcium (g/kg)</th>
<th>Ash (%)</th>
<th>Total organic matter (%)</th>
<th>Total carbon (%)</th>
<th>C:N ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td>7.275±0.301</td>
<td>10.185±1.177</td>
<td>4.93±0.443</td>
<td>2.719±0.171</td>
<td>1.69±0.35</td>
<td>1.99±0.012</td>
<td>4.86±0.027</td>
<td>18.0</td>
<td>8.195±0.471</td>
<td>81.920±0.274</td>
<td>279.33:1</td>
</tr>
<tr>
<td>FYM</td>
<td>8.088±0.068</td>
<td>48.803±4.606</td>
<td>2.871±0.228</td>
<td>1.501±0.100</td>
<td>9.21±0.75</td>
<td>8.268±0.559</td>
<td>27.396±2.673</td>
<td>63.942±3.560</td>
<td>37.176±2.070</td>
<td>40.36:1</td>
<td></td>
</tr>
<tr>
<td>Poultry Carcass</td>
<td>6.559±0.085</td>
<td>62.480±0.871</td>
<td>2.88±0.209</td>
<td>1.449±0.099</td>
<td>8.744±3.375</td>
<td>1.024±0.355</td>
<td>3.545±0.471</td>
<td>1.130±0.570</td>
<td>84.630±2.011</td>
<td>5.63:1</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSIONS

Physical Changes: During summer the temperature profile reached the peak by 2\textsuperscript{nd} week and started declining steadily (Fig. 1) and reached the level below 35 to 40°C, which is the recommended level for maximum microbial diversity\textsuperscript{[15,16]}. The second heating...
Consecutive days is recommended for effective microbiological activity due to thermal inactivation of broiler manure co-composted with straw. But the main disadvantage of high temperature above 60°C is decline in microbial activity due to thermal inactivation of favourable microorganisms.

Compost temperature above 55°C for three consecutive days is recommended for effective elimination of pathogenic microorganisms. In this work also the persistency of thermophilic temperature was significantly (P<0.01) higher in T₁ (54 days) and T₂ (65 days) than the control bin (17.5 days), which ensures maximum pathogen elimination.

Dead bird compost took significantly (P<0.01) longer period (Table 3) to complete decomposition process (116.5 to 127.5 days) than the compost bin without dead birds (107 days). Relatively shorter duration (14 to 20 days) was reported for dead bird compost with poultry manure by Murphy et al. But Cummins et al. reported 43 days and more to finish composting of dead birds. The reported periods were for temperate and subtropical climate and from the results it could be inferred for tropical summer climate prolonged the composting process beyond 100 days.

Fig. 1: Temperature profile during dead bird composting.

Table 3: Mean ± SE of physical changes during composting of dead birds

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Peak temperature (°C)</th>
<th>Persistence of thermophile temperature (days)</th>
<th>Composting period (days)</th>
<th>Moisture (%)</th>
<th>Weight reduction (%)</th>
<th>Volume reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>66.69±1.44</td>
<td>54.0±4.0</td>
<td>116.5±1.5</td>
<td>30.544±2.122</td>
<td>46.05±2.67</td>
<td>59.32±3.39</td>
</tr>
<tr>
<td>T₂</td>
<td>69.10±2.06</td>
<td>65.0±23.0</td>
<td>127.5±4.5</td>
<td>28.740±2.519</td>
<td>41.14±9.43</td>
<td>50.00±1.69</td>
</tr>
<tr>
<td>T₃</td>
<td>51.82±4.30</td>
<td>17.5±4.5</td>
<td>31.07±0.0</td>
<td>39.847±2.175</td>
<td>31.80±6.35</td>
<td>39.41±5.51</td>
</tr>
</tbody>
</table>

Figures with different lowercase columnwise differ significantly (P<0.01)

Table 4: Mean ± Physiochemical properties of dead bird compost

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH</th>
<th>EC in mS/cm</th>
<th>Total organic carbon (%)</th>
<th>Total nitrogen (g/kg)</th>
<th>C:N</th>
<th>Calcium (g/kg)</th>
<th>Phosphorus (g/kg)</th>
<th>Potassium (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>7.89±0.019</td>
<td>3.59±0.074</td>
<td>23.63±0.792</td>
<td>13.77±0.552</td>
<td>17.563±1.133</td>
<td>33.820±1.189</td>
<td>11.564±0.401</td>
<td>22.400±0.321</td>
</tr>
<tr>
<td>T₂</td>
<td>8.011±0.167</td>
<td>2.984±0.242</td>
<td>24.058±0.748</td>
<td>12.750±0.629</td>
<td>19.277±0.926</td>
<td>29.007±0.680</td>
<td>11.033±0.250</td>
<td>23.375±0.685</td>
</tr>
<tr>
<td>T₃</td>
<td>8.099±0.036</td>
<td>3.213±0.176</td>
<td>21.212±0.712</td>
<td>9.967±0.723</td>
<td>22.045±1.058</td>
<td>28.603±0.921</td>
<td>11.854±0.754</td>
<td>20.267±0.299</td>
</tr>
</tbody>
</table>

Figures with different lowercase columnwise differ significantly (P<0.01)

Table 5: Mean ± of microbial quality of dead bird compost (as log cfu/g) during different stages of composting

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total bacterial count</th>
<th>Coliform count</th>
<th>Salmonella count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>End of primary stage</td>
<td>End of secondary stage</td>
<td>End of primary stage</td>
</tr>
<tr>
<td>9.52±0.14</td>
<td>5.16±0.27</td>
<td>7.50±0.21</td>
<td>7.89±0.20</td>
</tr>
<tr>
<td>9.20±0.09</td>
<td>7.78±0.12</td>
<td>7.74±0.09</td>
<td>7.98±0.16</td>
</tr>
<tr>
<td>9.48±0.20</td>
<td>5.30±0.23</td>
<td>7.63±0.16</td>
<td>6.84±0.22</td>
</tr>
</tbody>
</table>

Figures with different lowercase columnwise differ significantly (P<0.01)
Moisture content (Table 3) of finished compost ranged between 28.74 and 39.847 and treatment mixture T1 (30.54%) and T2 (28.74%) showed significantly (P<0.01) lower moisture than control bin T3 (39.847%) indicating that straw and hay had poor moisture holding capacity. Weight reduction was higher in T1 (46.05%) followed by T2 (41.14%) than control (31.80%). Similarly volume reduction was also significantly (P<0.01) higher in dead bird compost mixture than control mixture (Table 2) which is higher than the reported values of 25 to 30 per cent by Murphy[17] and McCaskey[21] for dead bird compost with poultry manure as substrate and comparable with the values of 50 to 60 per cent for hog compost reported by Fonstad et al.[24].

In this study no obnoxious odour or fly menace was noticed during the study period. The paddy straw and sorghum hay are effective in controlling the odour and they acted as biofilter. The high temperature generated during composting process create an unfavourable environment for fly breeding also.

**Physicochemical Changes:** The acceptable range of pH at the end of composting is 7.5 to 8.0 regardless of beginning pH[26]. In this experiment the dead bird compost with FYM as manure substrate are with the acceptable range. The quantity of calcium, magnesium, sulphate, sodium, chloride and other ions are responsible for EC and the EC was significantly higher in T1 followed by T2 and T3.

The treatment mixture with FYM (T1 and T2) group showed uniformity in TOC indicated that both the carbon sources (straw and hay) are effective and equally degradable. Similarly the total nitrogen content (table 4) was significantly (P<0.01) higher in dead bird compost mixture than control compost, which indicated that carcass compost increased the fertilizer value of compost. In agronomical point of view, it is helpful to the farmers in efficient disposal of dead birds. This fact was supported by Fonstad et al.[24] that addition of hog carcass in the compost mixture increased the level of N by 108 per cent in the finished product. The C:N ratio was significantly lower (Table 3) in compost mixtures with dead birds than control. The C:N ratio below 20 can be considered satisfactory for compost maturity, when the initial C:N ratio is between 25 and 30[25] and it could not be an absolute indicator for compost maturation[26]. Most of the compost recipes in the present study had a C:N ratio below 20 hence are considered matured. Vuorinen and Saharinen[27] reported the C:N ratio decreased from 22.6-28.5:1 to 21.8-26.9:1 while composting cattle manure and further reduction was noticed during curing (12.7-13.6). Similar drastic reduction was also noticed by Inbar et al.[29] in liquid cattle manure from 27.1:1 to 8.1:1 during composting process. Similarly in this study also, heavy reduction in C:N ratio was noticed in FYM compost indicating higher decomposition in cattle manure compost. The calcium and phosphorus content of dead bird compost was also most uniform as that of control mixture and dead birds did not showed any significant effect on Ca and P content of finished compost. On the other hand potassium content was significantly higher in treatment mixture than compost mixture without dead birds.

**Microbial Changes:** The total bacterial count (TBC) was reduced from the initial compost to the end of primary stage and there after the microbial stabilization was noticed indicating that the mesophilic organisms decreased significantly (table 5) due to higher pile temperature during the first heating cycle but they are reestablished again at the end of second phase of heating cycle. Similar fluctuation was noticed by Tiquia and Tam[8] and Hassen et al[16].

The presence of coliform bacteria is often used as an indicator of overall sanitary quality of soil and water environment. Use of an indicator such as coliform, against actual disease causing organisms is advantageous as the indicators generally occur at higher frequencies than the pathogens and are simple and safer to detect[15]. In this experiment also, an attempt was made to enumerate total coliforms as an indicator of pathogenic microorganisms. The coliform count was higher at the time of loading composting bins mainly due to additions of dead birds and good reduction in coliform count was noticed at the end of primary heating cycle and the trend was continued up to end of composting cycle (Table 5). In the finished compost the coliform count was significantly (P<0.01) lower in T1 and T2 than control group. Similar reduction was also reported by Tiquia et al.[28] while composting spent pig litter and Ramos et al.[30] while composting cow manure with tannery effluent and wheat straw. The reduction was due to unfavorable condition (65 to 70°C) established during the thermophilic phase[16].

The treatment mixtures with dead birds showed significantly higher levels of Salmonella count (Table 5). The addition of dead bird might be attributed to the increase in Salmonella level. At the end of first phase of composting the Salmonella count showed similar decreasing trend as that of coliform count. There was a drastic reduction in the count to non detectible level at the end of composting process, indicating the mixing of compost mixture eliminated maximum number of organisms. The destruction of Salmonella by the composting process was reported by Murphy[31], Cummins et al.[22]; Donald et al[6]; Tiquia et al[29]and Das et al[12].

In the present study, parasitic egg determination was only carried out and the results showed that parasitic eggs could not be detected at the completion of both first and second heating cycles, indicating that the parasitic eggs were destroyed by the increase in bin temperature. Hauge[18] stated that the average temperature of 55 to 60 °C for a day was sufficient to eliminate protozoa (including cyst) and helminthes ova to a acceptably low level. Even at a temperature of 40 °C

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**References:**

- Fonstad et al.[24]  
- Murphy[17]  
- McCaskey[21]  
- Tiquia et al.[28]  
- Donald et al[6]  
- Tiquia et al[29]  
- Das et al[12]  
- Hauge[18]  
- Cummins et al.[22]  
- Salmonella
the Ascaris egg and other helminthes eggs were reduced to a non-detectible level [30].

**Conclusions:** This experiment revealed that the dead birds from the commercial poultry farms can be effectively composted with FYM and the resulted end product is richer in N content. The temperature profile of the compost piles favours the elimination of pathogenic microbes and parasitic eggs, which ensures biosecurity of the poultry farms. Higher weight and volume reduction and the favourable pH of the finished compost ensure the safety to land application.

**REFERENCES**


