J. Environ. Sci. & Natural Resources, 6(1): 141 - 144, 2013 ISSN 1999-7361

Effect of Bulking Materials on Composting of Layer Litter

F. Alam, M. A. Hashem, M. M. Rahman, S. E. M Rahman, M. M. Hossain and Z. Rahman

Department of Animal Science, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh.

Abstract: The experiment was carried out to examine the possibilities of making compost by using layer litter with different bulking materials and to assess the nutritive value of compost. To fulfill the objectives five treatments were considered e.g., anaerobic composting with layer litter (T_1), layer litter with straw (T_2), layer litter with tree leaves (T_3), layer litter with crop residues (T_4) and layer litter with saw dust (T_5) under soil surface. The samples from composted materials were collected at 0, 10, 20 and 30 days for proximate analysis. At 0 day of layer litter composting DM content did not vary significantly ($p>0.01$) varied in all treatments. At 10 day of layer litter composting DM content was the highest in T_4 (50.0%) and CF content was the highest in T_2 (22.2%). CP content remained similar varied in all treatments. At 20 day of layer litter composting DM content was highest in T_4 (51.5%), CP content was the highest in T_4 (19.5%), CF content was the highest in T_2 (18.0%), Ash content was the highest in T_4 (18.5%). At 30 day of layer litter composting DM content was the highest in T_2 (51.1%) and CP content was the highest in T_4 (17.6%). The pH value decreased upto first tendays then gradually increased with the composting period and highest value was obtained by T_1 (8.40) then followed by T_2 (8.20), T_3 (8.15), T_5 (8.10) and T_4 (8.00) ($p<0.01$) at 30 d of composting. The C/N ratios increased ($p<0.01$) in all treatments with the advancing of composting period and highest value was obtained in T_4 (27.9) followed by T_1 (26.7), T_5 (26.3), T_3 (26.2) and T_2 (25.3) considerably with the composting period. So, it may be concluded that proximate composition of all samples at 20 days in T_4 treatment was acceptable up to the end of composting period. However, composting layerlitter with crop residues (T_4) was more effective compare to other treatments at 20 days of composting in terms of Dry matter, CP content, C/N ration and pH.

Key words: Bulking agents, Chemical composition, Layer litter

Introduction

Poultry industry is growing rapidly and successfully becoming a leading industry in Bangladesh. Islam (2003) stated that there is no doubt that exciting times lie ahead for the Bangladesh poultry industry. Akter and Uddin (2009) reported that poultry industry as a fundamental part of animal production is committed to supply the nation a cheap source of good quality nutritious animal protein in terms of meat and egg. Although poultry industry plays a key role in developing our socio-economic and health sector, it might also be a great threat to our environment. Producers and researchers are exploring many ways to address environmental sustainability and constraints problems while adding value and improving transportability of manure to offset the costs of management practices. Poultry manure is an excellent fertilizing material because of its high nutrient content, especially for supplementing nitrogen (N), phosphorus (P), and potassium (K). These nutrients plus others come largely from the bird feces (Williams *et al*., 1999; Harmel *et al*., 2009).Manures decompose (mineralize) in soil releasing nutrients for crop uptake. In addition to supplying nutrients, poultry manure or litter serves as a soil amendment increasing soil organic matter content. The added organic matter increases the moisture holding capacity of the soil, lowers soil bulk density, and improves overall soil structure, thus increasing the efficiency of the crop production and irrigation (McGrath*et al*., 2009). Composting poultry litter is a technique that should produce a stable organic mass with limited nutrient loss. The composting process reduces the bulk density of litter, minimizes odor, and improves public perception. Compost pile needs a proper ratio of carbon-rich materials, and/or nitrogen-rich materials. Mixing certain types of bulking materials both carbon-rich materials and nitrogen rich materials with layer litter changes the rate of decomposition and quality of compost (Cobb and Rosenfield, 1991). Therefore, the present study was undertaken to determine the effectiveness of different bulking materials in reducing time of composting layer litter and to assess the quality of the end product as manure.

Materials and Methods

The experiment was carried out in the Goat and Sheep farm, Department of Animal Science, Bangladesh Agricultural University, Mymensingh, for the period of 30 days i.e. from 01 February to 01 March 2012. The experiment was laid out in a Complete Randomized Design (CRD) with 3 replicate in each treatment. A place of comparatively high land was selected to prepare 15 similar pits whose diameter were 75 cm and depth 45 cm. Polyethylene bags were set at the bottom and side wall of the pits to prevent leaching and water contamination from compost. After collection, all bulking materials except the

sawdust were cut by chopping machine to mix properly with layer droppings. The treatments of the experiment were only layer litter (T_1), layer litter with straw (T_2), layer litter with tree leaves (T_3), layer litter with crop residues (T_4) and layer litter with saw dust (T_5).

In each treatment, 20 kg layer droppings were mixed with the bulking materials to fix the moisture level at 50%. After proper mixing of the materials, sample was collected from each treatment for chemical analysis. Then the materials were placed in previously prepared pits according to the treatment, covered with eight cm soil layer and kept for 30 days. For chemical analysis samples were taken at 10 days intervals from all composting pits and pH of compost was determined by using a laboratory pH -mV meter (ino Lab, Germany) after putting 2g sample in 50 ml distill water. Dry matter was determined by drying the compost at 65°C for 48h. Crude Protein (CP) was measured using Kjeldahl method (N × 6.25) while other proximate constituents, ether extract (EE), ash, crude fiber(CF) and nitrogen free extract (NFE) were determined according to procedures described by AOAC (2004). For determination of carbon nitrogen (C/N) ratio, Carbon is calculated from organic matter divided by 1.73 factors and nitrogen from crude protein divided by 5.88 constant factors. The C/N ratio is a parameter used to determine the compost is nitrogen stable. The data were analyzed using the "SAS" statistical program to compute analysis of variance (ANOVA) for a Completely Randomized Design (CRD) and significant mean values were tested with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

pH values of compost at different days

The pH value of composting differed significantly ($p<0.01$) between treatments. The pH value decreased up to first ten days then gradually increased with the composting period. The pH value was higher in T_1 (8.40) followed by T_2 (8.20), T_3 (8.15), T_5 (8.10) and T_4 (8.00) at 30 d of composting period. The lower p^H of compost indicates good fermentation quality which was due to presence higher water soluble carbohydrates (Hadjipanayiotou, 1982). Jacob *et. al.* (1997) observed that at first up to ten days pH value decreased and then gradually increased with prolonging the composting period.

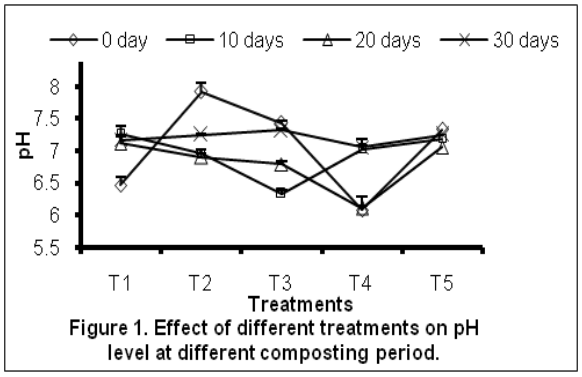

Figure1. Effect of pH on layer litter compost at different days

C/N ratio of compost at different days

The C/N ratios increased in all treatments with the program of composting period (figure 2). It differed significantly ($p<0.01$) in all treatments and the highest value was obtained in T_4 (27.9) followed by T_1 (26.7), T_5 (26.3), T_3 (26.2) and T_2 (25.3) at 30 days of composting considerably with the composting period. The results were consistent Ngele *et. al.* (2006) but contradicts with Abdelmawa *et al.* (1988) when composted by staking.

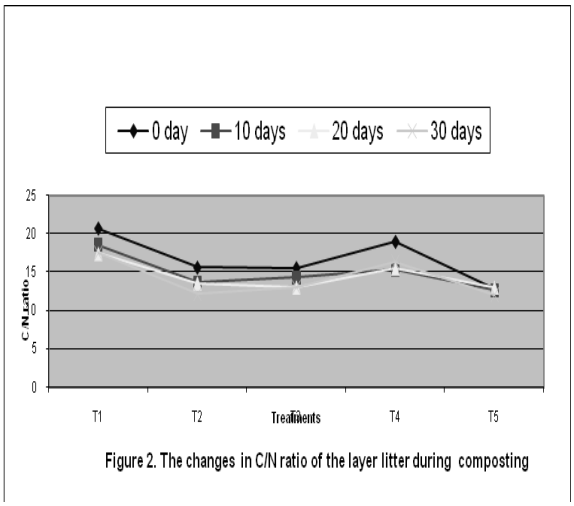

Figure2. The changes in C/N ratio of the layer litter during composting

Chemical composition of compost at different days

The nutritive value of the compost was significantly influenced by the bulking materials in all treatments (Table 1). At 0 d of composting, DM content did not significantly ($p<0.01$) vary in all treatments. The highest crude protein (CP) content was observed in compost of layer litter with crop residuesT_4 (18.0%) and only layer litterT_1 (17.7%) which was significantly ($p<0.01$) different from other treatments. The highest crude fibre (CF) was observed in compost with layer litter and straw, which was

significantly ($p<0.01$) higher from other treatments. Ash contents differed significantly ($p<0.01$) in all treatments. At 10 d of layer litter composting, DM content differed significantly ($p<0.01$) among treatments and the highest DM content was observed in compost with layer litter and crop residues T_4 (50.0%) whereas lowest in only layer litter T_1(46.8%) compost. Crude protein (CP) content did not vary significantly ($p<0.01$) in the treatments. Crude Fibre (CF) and ash content was varied significantly ($p<0.01$) in all treatments. The highest ash content (17.1%) was observed in compost with layer litter and sawdust.

Table 1. Effect of different bulking materials on chemical composition (%) of compost at different days

Treat.	DM				CP				CF				Ash			
	0-d	10-d	20-d	30-d	0-d	10-d	20-d	30-d	0-d	10-	20-d	30-d	0-d	10-d	20-	30-d
T_1	46.0	46.8^{e}	50.9^{a} b	48.2^{e}	17.7^{a} b	17.0	17.1 b	16.5 b	18.4 d	15.2 e	15.1^{e}	13.3 d	13.0^{c}	13.9d e	15.8^{d}	15.8 d
T_2	46.2	47.8 d	49.9 d	51.1^{a}	14.2^{e}	16.0	15.0^{e}	14.8^{e}	22.2 a	19.0 a	18.0^{a}	16.9^{a}	13.4^{c}	14.0^{d}	16.2^{c}	15.0 e
T_3	46.2	48.2^{c}	49.1^{e}	49.9^{c} d	16.0^{c}	16.6	16.8 bc	16.2 bc	21.3 b	17.4 c	16.3 bc	15.0 b	14.0^{b}	15.2^{c}	17.2^{b}	16.9 b
T_4	46.0	50.0^{a}	51.5^{a}	50.0 bc	18.0^{a}	17.1	19.5^{a}	17.6^{a}	20.0 c	16.1 d	15.8 d	14.1^{c}	15.3^{a}	16.2^{b}	18.5^{a}	18.0 a
T_5	46.2	49.1 b	50.2^{c}	50.5 b	15.0 d	16.3	15.7 d	15.4 d	21.2 b	18.3 b	16.7 b	15.2 b	14.4^{b}	17.1^{a}	17.4^{b}	16.2 c
LS	NS	**	**	**	**	NS	**	**	**	**	**	**	**	**	**	**

**, $p<0.01$, NS, non significant, Mean values in same column with different superscript differ significantly ($p<0.01$), LS = Level of Significance, T_1 = only layer litter, T_2= Layer litter with straw, T_3 = Layer litter with tree leaves, T_4= Layer litter with crop residues, T_5 = Layer litter with sawdust

At 20 d of layer litter composting, the highest DM content was observed in compost with layer litter and crop residues (51.5%) which was statistically identical to compost with only layer litter (50.9%).Crude protein (CP) content was also highest in compost with layer litter and crop residues (19.5%). Crude Fibre (CF) content was highest (18.0%) in compost with layer litter and straw and the lowest in compost with only layer litter (15.1%). The highest ash was observed in compost with layer litter and crop residues (18.5%). The same results were found by Coddling (2006) and Taufik *et al.* (1997).In contrast to the foregoing trend, crude fiber declined with increased the composting period from 22.2% in treatment T_2, 14.1% in treatment T_4(Table 1).Magar and Fontenot (1988) and Rasool *et al*. (1996) also observed a similar trend.

At 30 d of composting, the highest DM content (51.1%) was observed in compost made from layer litter and straw, followed by compost with layer litter and crop residues, compost with layer litter with sawdust, compost with layer litter with tree leaves and compost with only layer litter. The highest CP content was observed in compost with only layer litter which was statistically identical to compost with layer litter and crop residues. Crude fibre (CF) content was similar in compost with only layer litter and compost with layerlitterand crop residues. Ash contents differ significantly ($p<0.01$) in all treatments and highest value (18.0) was observed in compost with layer litter and crop residues.

In this study compost with layer droppings and crop residues showed highest dry matter content(51.5%) at 20 d of composting to compare that at 30 d of composting. The same result was also observed by Adeley and Kitts (1983) and Muller (1982) who reported that dry matter content decreased during composting period. The ash contents of all treatments were virtually higher than the control significantly ($P<0.01$). From Table 1, it is revealed that Treatment T_4 gave the highest (18.5%) ash content, followed by T_5, $T_3$and T_2at 20 days of composting. The lowest ash content was obtained by the control treatment. This contrast with the findings of Flachowsky and Hennig (1990) who observed a linear increase in ash with increased composting period.

Conclusion

The results suggest that composting layer litter with crop residues significantly improves the nutritional values of compost at 20d of composting and may be a feasible means of preserving and converting layer droppings, into good manure for growing plant.

References

Abdelmawla, S. M.; Fontenot, J. P and El-Ashry, M. A. 1988. Composited, deep stacked and ensiled broiler litter in sheep diets: Chemical

composition and nutritive value study. *Anim. Sci. Res. Rep.,* 7: 127.

Adeleye, I.O.A. and Kitts, W. D. 1983. Poultry wastes as feed for ruminants II. Effect of age of chemical composition of broiler litter and caged layer droppings. Tropical Anim. Prod. 8: 15-18.

Akter, S. and Uddin, M. 2009. Bangladesh poultry industry. *J. Business and Technology*, 4:97-112.

AOAC. 2004. Association of the Official Agricultural Chemists, Official methods of analysis. Washiington, DC. P. 1-34.

Cobb, K. and Rosenfield, J. 1991. Municipal Compost Management. Cornell University Waste Management Institute.

Coddling, E. E. 2006. Laboratory characterization of extractable phosphorus in poultry litter and poultry litter ash. *Soil Sci.,* 171: 858-864.

Gomez, K.A. and Gomez, A. A. 1984. Statistical procedure for Agricultural Research. 2nd End. New York: John Wiley and Sons. P.680.

Hadjipanayiotou, M. 1982. Laboratory evaluation of ensiled poultry litter. *Animal Production,* 35: 157-161.

Islam, 2003. Demand projections for poultry products and poultry feeds in Bangladesh. No. 54, MSSD discussion papers from International Food Policy Research Institute (IFPRI).

Magar, S. M. and Fontenot, J. P. 1988. Nutritional value of ensiled deep pit caged layer waste-corn forage mixtures. Virginia Technical Livestock Research Report No 7, Blacksburg, pp: 133-136.

McGrath, S.; Maguire, R. O.; Tacy, B. F and Kike, J. H. 2009. Improving soil nutrition with poultry litter application in low input forage systems. *Agronomy J.,* 102: 48-54.

Ngele, M. A.; Adegbola, T. A. and Bogoro, S. E. S. 2006. Nutritive value of rice straw treated with poultry litter. Proceedings of the 31st Annual Conference of Nigerian Society for Animal Production, March 12-15, Bayero University, Kano, pp: 18-21.

Taufik, D. E.; Said, G. and Maarif, M. S.1997. Study of preparation of organic fertilizer through the composting of domestic wastes using liquid mud of oxidation pond. Technology industry pertanian. In: organic recycling in Asia and the pacific, rap bull. Reg. Office for the Asia and the Pacific, Food and Agril.Org, Bangkok, Thailand. 13: 67.

Williams, C. M.; Barker, J. C. and Sims, J.T. 1999. Management and utilization of poultry wastes. Rev. *Environ. Contamination and Toxicology,* 162: 105-157.