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Changes in weight and volume of poultry farm waste during composting

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Abstract
The present study was conducted in the Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry (SKUAST- Kashmir) to assess the different physical changes in the farm of weight and volume reduction while composting of poultry form waste under the agroclimatic conditions of Kashmir Valley. Poultry farm waste in the form of poultry carcass (dead birds) and poultry litter was selected for this purpose. Four treatment recipes formulated for composting were: T_1: Poultry carcass + Poultry litter, T_2: Poultry carcass + Poultry litter + Paddy straw, T_3: Poultry carcass + Poultry litter + Effective Microbes and T_4: Poultry carcass + Poultry litter + Paddy straw + Effective Microbes. The overall highest weight reduction of 20.52 and 19.65 percent was observed in treatment group T_2 (containing paddy straw) at the end of primary and secondary stages, respectively. Similarly, overall highest volume reduction of 22.39 percent was observed in T_4 (containing paddy straw and effective microbes) at the end of primary stage and 9.17 percent in T_1 (control group) at the end of secondary stage. It was concluded that composting significantly reduces the weight as well as volume of the waste material to a significant level.

Keywords: Weight reduction, volume reduction, poultry farm waste, composting

1. Introduction
Modern day poultry has transformed in to a full fledged industry due more commercialization and diversification [1]. Vigorous farming activity has resulted in the generation of large volumes of poultry farm waste. Quick and prompt disposal of such waste is important for maintaining of proper and effective bio-security of birds and humans as well [2]. Composting is a controlled natural process in which beneficial microorganisms (bacteria and fungi) reduce and transform organic waste into a useful end product called compost [3]. Composting of dead birds and poultry manure [4] is recommended as an eco-friendly process with less cost and labour involvement and provides an opportunity for reducing of weight and volume of the quantum of waste [5]. The end product of compost resembles humus and can be used as soil amendment. Composting reduces the volume of the organic waste and pathogens are destroyed if the process is controlled properly [6]. The microbial decomposition and disintegration of organic matter present helps in reducing the bulk of the waste matter. The objective of the study was to assess the weight and volume reduction changes in composting of poultry farm waste during different seasons.

2. Materials and Methods
The present study was carried out in the Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry Shuhama Srinagar (SKUAST-Kashmir). The site of experimentation was situated in the north western region of Srinagar (Jammu and Kashmir). Poultry farm waste (dead birds and poultry litter) was utilized to study the composting and fermentation experiments in two separate trails during summer and winter seasons. Composting of poultry litter was done in wooden bins (Mini composter) with a specification of 3 feet length x 3 feet width x 3 feet height designed as per the method of Donald [7]. The floor of the compost bin was made impervious to prevent seepage of leachiates and subsequent moisture and nutrient loss. The sidewalls of the compost bins were made up of country wooden planks of 4 to 5 inches wide and one inch thick. An air space of 1-2 inch was provided between wooden planks to aid sufficient aeration to the compost piles. Dead birds for the present study were collected from local poultry farms and stored at – 5 ^{o}C till sufficient carcasses were made available to fill all the compost bins in a single day.

Similarly, poultry litter was collected from poultry farm of LPM. Paddy straw (*Oryza sativa*) was used as a carbonaceous as well as bulking agent wherever it was required. Paddy straw was purchased from farmer's field and stored in advance. Four compost recipe treatments (with three replicates in each treatment) were formulated with addition of effective microbial culture (*Lactobacillus plantarum, Lactobacillus casei, Saccharomyces cerevisiae and Rhodopseudomonas palustris*) in two treatments as shown in Table. 1. Total weight of the compost ingredient at the time of initial loading followed by the end of primary stage and secondary stage was recorded. From the initial and final weights, the percentage of weight loss was calculated accordingly. Total bin volume was calculated after filling the bin with compost mixture (length x width x height) and reduction in volume was recorded at the end of primary stage and secondary stage separately. From the initial volume and final volume percentage of volume reduction was calculated.

Table 1: Different Treatments Combination for Composting

Treatments	Description
Treatment 1	Dead birds + Poultry litter (Control)
Treatment 2	Dead birds + Poultry litter + Paddy Straw
Treatment 3	Dead birds + Poultry litter + Effective Microbes
Treatment 4	Dead birds + Poultry litter +Paddy straw + Effective Microbes

2.1 Statistical analysis
The data was statistically analyzed as per the methods suggested by Snedecor and Cochran [8] SPSS software was used for comparing the means using one way ANOVA.

3. Results
3.1 Weight Reduction
At the primary stage, the significantly ($P \leq 0.05$) highest weight reduction was observed in T_3 having effective microbes (23.52 percent) and T_2 having paddy straw (19.70 percent) respectively during winter and summer seasons (Table. 2). While as lowest weight reduction of 9.30 percent in T_1 and 12.58 percent in T_4 was observed respectively during winter and summer seasons. Weight reduction significantly ($P \leq 0.05$) varied in T_1, T_3 and T_4 during different seasons. The overall highest weight reduction of 20.52 percent was observed in T_2 in which paddy straw was added as a carbon source. At the secondary stage, significantly ($P \leq 0.05$) highest weight reduction of 22.48 percent in T_1 and 32.74 percent in T_2 was observed respectively during winter and summer seasons. Significant ($P \leq 0.05$) effect of season on weight reduction was observed in T_2 and T_3. The overall highest weight reduction of 24.65 percent was observed in T_2 in which paddy straw as a carbonaceous source was added.

3.2 Volume Reduction
At the end of primary stage, significantly ($P \leq 0.05$) highest volume reduction of 25.57 and 19.21 percent was observed in T_4 containing paddy straw and effective microbes (Table. 3). Significantly ($P \leq 0.05$) lowest volume reductions of 9.09 and 9.78 per was observed in T_1 respectively during winter and summer seasons. The effect of different seasons on volume reduction varied significantly ($P \leq 0.05$) in treatment groups T_3 and T_4 only. The overall highest volume reduction of 22.39 percent was observed in treatment group T_4 in which paddy straw and effective microbes were added. At the end of secondary stage, the highest volume reduction of 5.52 percent in T_3 and 12.95 percent in T_1 was observed respectively during winter and summer seasons. Similarly the lowest volume reduction was observed as 5.29 and 9.67 percent in T_4 respectively during winter and summer seasons. Significant ($P \leq 0.05$) effect of season was observed in the different treatment groups. The overall highest volume reduction observed was 9.17 percent in treatment group T_1.

Table 2: Percent weight reduction during different stages and seasons of composting (Mean± SE).

Treatment	Primary stage			Secondary stage		
	Winter	Summer	Overall	Winter	Summer	Overall
T_1	$^{A}9.30\pm0.51^{a}$	15.18 ± 2.33^{b}	12.24 ± 1.92	$^{AB}19.22\pm2.38$	$^{BC}21.02\pm1.15$	20.12 ± 3.32
T_2 (Paddy Straw)	$^{AB}21.35\pm1.11$	19.70 ± 3.16	20.52 ± 1.54	$^{A}16.57\pm0.5^{a}$	$^{B}22.74\pm2.28^{b}$	19.65 ± 2.42
T_3 (Effective Microbes)	$^{B}23.52\pm0.66^{a}$	14.04 ± 1.04^{b}	18.05 ± 1.40	$^{B}22.48\pm0.74^{a}$	$^{A}12.14\pm1.19^{b}$	17.31 ± 2.2
T_4 (Paddy Straw+ Effective Microbes)	$^{B}23.51\pm1.20^{a}$	12.58 ± 1.12^{b}	18.04 ± 2.75	$^{A}15.60\pm1.85$	$^{A}16.76\pm1.19$	16.18 ± 1.0

Figures with different small superscripts row wise and capital superscripts column wise differ significantly ($P<0.05$).

Table 3: Percent volume reduction during different stages and seasons of composting (Mean± SE).

Treatment	Primary Stage			Secondary Stage		
	Winter	Summer	Overall	Winter	Summer	Overall
T_1	$^{A}9.09\pm1.32$	$^{A}9.78\pm0.86$	9.43 ± 1.44	5.39 ± 0.32^{a}	12.95 ± 1.54^{b}	9.17 ± 0.72
T_2 (Paddy Straw)	$^{A}15.73\pm4.01$	$^{B}17.93\pm1.27$	16.83 ± 3.78	5.25 ± 0.38^{a}	11.21 ± 1.18^{b}	8.23 ± 3.07
T_3 (Effective Microbes)	$^{A}15.88\pm2.69^{a}$	$^{A}10.17\pm0.74^{b}$	13.02 ± 2.76	5.52 ± 0.52^{a}	11.43 ± 0.70^{b}	8.47 ± 0.10
T_4 (Paddy Straw+ Effective Microbes)	$^{B}25.57\pm0.83^{a}$	$^{B}19.21\pm0.64^{b}$	22.39 ± 0.07	5.29 ± 0.40^{a}	9.67 ± 0.76^{b}	7.48 ± 0.21

Figures with different small superscripts row wise and capital superscripts column wise differ significantly ($P<0.05$).

4. Discussion
4.1 Weight Reduction
Weight loss directly reflects the rate of decomposition of organic matter by microorganisms. At the end of primary stage during winter season significantly ($P<0.05$) higher weight reduction of 23.51 percent in T_4 (with paddy straw and effective microbes) and 23.52% in T_3 (with effective microbes) was noticed when compared with T_1 the control group (Table. 4.5 and Figure: 4.3). Better microbial degradation favored by the effective microbial cultures attributed to the higher percentage of weight reduction. However during summer season the comparative weight reduction in the treatment group T_3 with 14.4 percent and T_4 with 12.58 percent was lower as compared to other treatments because of the considerably higher initial moisture content of the composting material. The overall weight reduction in the T_3 and T_4 was better because of addition of paddy straw (carbonaceous source) which favored the microbial degradation. The comparable results were earlier observed by McCaskey [9] who reported a weight reduction of 8.2 to 28.8

percent in carcass compost. Similarly Henry and White [10] reported a range of 22.6 to 25.2 percent weight reduction in broiler litter compost. At the end of secondary stage the overall weight reduction was highest (20.12%) in treatment group T_1 (control group) followed by 19.65% in treatment group T_2 (containing paddy straw). It was because of rejuvenation of the microbial flora due to turning at the end of primary stage. In rest of treatment groups of T_3 and T_4 the weight reduction was comparatively less because of already higher microbial degradation and utilization of organic matter at primary stage and hence thereafter slightly lesser degradation occurred during secondary stage. The season had no influence on weight reduction in both the stages of composting and the results were in agreement with the findings of Cekmecelloglu [11] who reported that there was no significant difference between summer and winter composting on weight reduction. However in contrast to present study Larney [12] observed significantly (P<0.05) higher weight reduction during summer (64.3 percent) than winter (39.5 percent) in beef feedlot manure compost. From the present results it could be inferred that addition of effective microbial mixture had better weight reduction potential.

4.2 Volume Reduction

The overall volume reduction at the end of primary stage of composting was highest in T_4 (22.39 percent) due to better degradation by the addition of effective microbes and carbonaceous source (paddy straw) and lowest in T_1 (control group) with 9.43 percent (Table. 3). In T_1 and T_2 there was no effect of season on volume reduction but there was significant (P<0.05) effect on T_3 (containing effective microbes) and T_4 (containing paddy straw and effective microbes). Similarly at the end of secondary stage the overall highest volume reduction was observed in T_1 (9.17 percent) and lowest in T_4 (7.48 percent). The reactivation of micro flora after turning in led to a considerable volume reduction at the end of secondary stage also. There was significant ($P \leq 0.05$) effect of season on volume reduction during secondary stage in all the treatment groups. These results obtained were comparable with the reports of Murphy [13] who recorded a volume reduction of 20 to 25 percent percent in dead bird compost in the present study and a volume reduction of 4.3 to 26.3 was observed by Mehta [14].

5. Conclusion

It was concluded that composting of poultry farm waste in the form of dead birds and poultry litter was drastically reduced in weight and volume due to consumption of organic matter by the microbes and the heat generation in the composting pile. Hence composting is an effective waste management technique for reducing the bulk of the waste.

6. Acknowledge

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