# Compost Quality Assessment of Various Agricultural Wastes and Organic Manures

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**Abstract**

Today the quality of compost is the most essential criterion in recycling organic wastes, as well as its marketing and utilization in agriculture. Environmentally safe recycling of organic waste to agricultural land could be crucial to sustaining soil productivity in Mediterranean areas, where soil organic matter content is very low. The present study discusses variations in some quality parameters of compost produced using various organic combinations. Over a period of 120 days, special attention was given to monitoring compost quality parameters, including: temperature, dry matter, pH, electrical conductivity (EC), microbial counts, organic matter (OM), organic carbon (OC), $NH_4$, $NO_3$, C:N ratio, macronutrients (NPK), and micronutrients (Fe, Mn, Zn, and Cu). The results revealed that almost all of the investigated parameters showed remarkable changes during compost formation. Agricultural wastes in the presence 10% poultry manure was comparatively of superior quality in terms of the availability of macro and micronutrients as well as microbial activity. However, agricultural wastes with 10% mixture of sheep and camel manure was found to be superior in terms of OM, OC, C:N ratio and yielded the highest bacterial counts. Compost quality depended on the base materials used, the duration and conditions of decomposition.

**Keywords:** Compost, Degradation, Manure, Organic Wastes

## 1. Introduction

Agricultural field crop residues and animal manure contribute a substantial amount of organic matter. These waste materials require landfill space, and are capable of posing various potential environmental threats (Neher et al. 2013). Composting is potential to sustain bio-organic agriculture and it's also a low cost. Compost formed by manure-crop residue mixtures can also increase levels of soil organic matter and organic carbon, enhance the availability of nutrients, improve soil texture, structural properties and biological activity (Lacatusu et al. 2016). Thus, the use of compost, particularly for degraded, marginal, and arid lands, is increasingly becoming more popular.

Although composting cannot be considered a new technology, composting recipes and the biochemical process of decomposition can vary widely based on the starting raw materials. Previous studies have used various composting recipes, methods, and organic materials (Recep et al. 2014). However, further comparative studies are necessary to analyze organic raw materials for compost quality. The biological dynamics of composting is poorly understood. The present study was based on the assessment of various quality attributes and designed to evaluate comprehensively diverse composting recipes comprising different agricultural wastes and the manure of different animal species.

## 2. Materials and Methods

The composting material consisted of two major categories of organic matter: a- agricultural wastes and b- animal dungs. Mixture of Palm branches, wheat straw, and vegetable crop shoots were collected as agricultural organic wastes. Three types of animal manure were used: poultry, cow, and mixed sheep & camel manure. Prior to the composting process, physicochemical properties of organic matter were determined according to the standard protocols recommended by the US Composting Council.

The experimental treatments comprised three crop residue and manure combinations (weight per weight) as follows: agricultural waste+10% cow manure; agricultural waste+10% poultry manure; and agricultural waste+10% mixed sheep & camel manure. Compost preparation was conducted twice during two summer seasons.

The three combinations of agricultural wastes and animal manure were decomposed as three separate heaps (25×10×1.5 m). Materials were placed layer by layer under medium-high temperature, with adequate moisture to hasten the process of composting by microbial activity. Calcium carbonate was added equally to the three heaps (at a rate of 2%). Each layer was also inoculated with a mixture of $1\times10^8$ each of *Streptomyces aureofaciens*, *Trichoderma viride*, *Trichoderma harzianum*, *Bacillus subtilis*, and *Bacillus licheniformis* at 1L $ton^{-1}$ as a microbial activator to accelerate decomposition. Following inoculation, all treatments were moistened; water was added to all windrows to readjust the moisture content to about 50%-65%. Every 15 days, the composting mass of the three heaps were mechanically turned upside down to facilitate proper mixing.

Temperature changes were measured using a laboratory thermometer. Aerobic mesophilic and thermophilic cellulose decomposing bacteria were counted using Doubs's cellulose medium procedure (Allen, 1982). After 0, 30, 60, 90 and 120 days, homogenized samples were taken to analyze EC, pH, organic matter, organic carbon, C:N, $NH_4$, $NO_3$, macronutrients (NPK), and micro-nutrients (Fe, Mn, Zn, and Cu). The parameters under investigation were considered to be indicative of compost quality and to optimize the composting process (Agnew and Leonard 2003). The Statistical Analysis System (SAS) was used for data analysis (SAS. 2001).

## 3. Results and Discussion

A negative relationship was evident between temperature and composting time; an increase in composting time led to a corresponding decrease in temperature. This finding could be attributed to a decrease in microbial and enzymatic activity (Neher et al. 2013).

Rapid degradation of agricultural waste was observed with the treatment included 10% poultry manure as the organic activator, in comparison to other treatments (10% cow manure or 10% mixture of sheep and camel manure). This may be due to an increase in microbial activity.

The C/N ratio is one of the main parameters affecting the composting process that is often used as an index of compost maturity (Table 1). Differences in C/N ratios over time could be attributed to changes in the amounts of available nitrogen and the loss of organic carbon during the composting process. C/N ratio below 20 was considered satisfactory to validate compost maturity (Jusoh et al 2013).

Total bacterial counts reached maximal levels after 8 weeks, and then decreased until the end of the composting period. The treatment of agricultural waste +10% mixture of sheep and camel manure yielded the highest bacterial counts, whereas agricultural waste +10% poultry manure yielded the lowest. These results due to the depletion of organic matter, mineralization, and reduced moisture content (Nuntavun et al, 2014).

During the composting process, levels of $NH_4$ decreased, whereas levels of $NO_3$ and total N increased across all treatments. These effects may be due to higher levels of oxidation of non-nitrogenous organic materials and partially to $N_2$-fixation by non-symbiotic nitrogen fixers. These findings reflect an increase in the rate of immobilization and conservation of nitrogen (Lacatusu et al 2017).

An increase in the concentrations of NPK and micronutrients was observed during the composting process across all treatments. Throughout the composting process, the poultry manure treatment was of superior quality in comparison to the other treatments under investigation.

**Table.1** Changes in Organic Carbon, N% and C/N ratio during composting process of agricultural wastes with different organic manures sources.

| **Time in days** | **0** | **30** | **60** | **90** | **120** |
|---|---|---|---|---|---|
| **Treatments** | | | **Organic Carbon (%)** | | |
| AW +10% cow manure | 46.38 a | 35.69 a | 29.73 a | 25.74 b | 26.09 a |
| AW +10% poultry manure | 43.83 a | 25.42 b | 27.16 a | 24.71 b | 24.16 a |
| AW +10% mixture of sheep and camel manure | 50.78 a | 36.84 a | 31.47 a | 27.47 a | 27.24 a |
| Mean | 46.99A | 32.65 B | 29.45 B | 25.97 C | 25.83 C |
| | | | **Nitrogen %** | | |
| AW +10% cow manure | 0.66 b | 1.09 b | 1.20 b | 1.25 b | 1.39 b |
| AW +10% poultry manure | 0.78 a | 1.19 a | 1.31 a | 1.36 a | 1.54 a |
| AW +10% mixture of sheep and camel manure | 0.69 b | 1.12 b | 1.24 b | 1.29 b | 1.46 b |
| Mean | 0.71 D | 1.33 B | 1.25 C | 1.30 B | 1.46 A |
| | | | **C:N (Ratio)** | | |
| AW +10% cow manure | 70.27 a | 32.74 a | 24.77 a | 20.59 a | 18.76 a |
| AW +10% poultry manure | 56.19 b | 21.36 b | 20.73 b | 18.17 a | 15.68 b |
| AW +10% mixture of sheep and camel manure | 73.59 a | 32.89 a | 24.38 a | 21.29 a | 18.65 a |
| Mean | 66.68A | 28.99 B | 23.29 C | 20.01D | 17.69D |

AW: Agricultural wastes

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