

# NUTRIENTS CONTENTS AND PHYSICAL PROPERTIES OF HOT COMPOSTING OF LOCAL ORGANIC WASTE IN DUHOK CITY\_ IRAQ KURDISTAN REGION

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## Abstract

The main objective of this research was to evaluate the different organic residue available in local area in Duhok province in Iraqi Kurdistan region for making four different hot compost during 18 days and evaluating some there physical and chemical quality indices. Result revealed that the first heap that formed from wheat hey and straw, sheep manure, brown garden residue, chicken manure, fruit and vegetable scrapes, contains significantly the lowest value of soluble calcium  $6.46 \pm 0.29$  to  $6.93 \pm 0.48$  meq/l and potassium  $4.39 \pm 0.04$  to  $5.87 \pm 0.03$  meq/l, while has the same contents of soluble magnesium and sodium meq/l and the lowest EC values. The second heaps that formed from brown grass clipping, fish meal, pine needle, green grass clipping, vegetable and fruits scrapes is better than first heaps for their Ca and K content but have the highest value EC of  $2.66 \pm 0.02$  ds.m<sup>-1</sup>. The third heap which formed from carton board and papers, slaughter waste, saw dust, brown garden residue, vegetable and fruit scrapes and forth heap which is a mixture of three above mentioned heaps in sequential are supreme significantly in their content of almost studied parameters. The lowest value of organic matter was observed in first heaps of  $30.77 \pm 0.8\%$ , while the highest value was recorded in forth heaps of  $64.36 \pm 5.43\%$ . the total nitrogen was obtained in third hep of  $3.16 \pm 0.25\%$ . the P range in all heaps are in allowable ranges, the fourth heap being the supreme on its total P contents, then second heap and ranges between  $0.47 \pm 0.02$  to  $0.85 \pm 0.02$ . The C/N ratio varies from  $10.45 \pm 1.6$  in third heap to  $25.65 \pm 1$  in first heap. The bulk density ranges between  $200 \pm 5$ -  $470 \pm 10$  kg.m<sup>-3</sup> of and the bulk density of third compost heap is significantly lower than the fourth heap which is significantly lower than first and second heaps. The porosity of various constructed heaps ranges between  $59.20 \pm 0.7$  to  $68.29 \pm 0.86\%$ . The final texture of finished matured compost by hot composting during 18 days is so fine to be considered as soil conditioner that improve almost soil chemical, physical, and biological properties of soil. So, it concludes that the third and fourth heaps are better than first and second heaps of all studied parameters.

**Keywords:** Mature Compost, Carbon/Nitrogen Ratio, Organic Matter, Total Nitrogen, Porosity, Moisture Content

## 1. INTRODUCTION

The breakdown of organic wastes in the presence of oxygen is known as composting. It is one of the best biological processes for turning trash into compost, a valuable substance. It is an economical, practical, and environmentally friendly method of managing organic waste. By lowering its volume and weight, it inevitably enhances the way organic wastes can be handled. (Yamada and Kawase, 2006). Fundamental environmental elements including temperature, moisture content, pH, aeration, and various aspects of organic waste (such C/N ratio, particle size, and nutrients) control the composting process (Silva MEF et al, 2014). In order to preserve soil fertility and reduce nutrient losses, organic matter must be present in the soil. As a result, compost is an excellent organic fertilizer because it also contains nutrients. In addition to contributing to the physical composition of soils, organic matter also serves as a platform for

biological activity. Moreover, organic matter contributes most to soil productivity. It gives the soil nutrients, increases its ability to store water, and aids in maintaining excellent tilth, which enhances aeration for seed germination and the growth of plant roots (Edwards and Hailu, 2011). The essential nutrients found in compost are; Nitrogen (N), Carbon (C), Potassium (K) and Phosphorus (P). In the process of composting, the carbon to nitrogen (C: N) ratio is a limiting element. When the carbon to nitrogen ratio is higher (40:1), microorganism development is restricted and the breakdown process is slowed down as a result (Zhu et al., 2007).

In contrast, if the ratio of carbon to nitrogen is less than 20:1, it results in the rapid mineralization of nitrogen and increases the risk of the surplus being released into the environment as ammonia or nitrous oxide, which causes odor issues (Jeong and Kim, 2001). Phosphorus (P), another important component in the composting process, is a non-volatile nutrient, meaning that it is not lost throughout the process but can leach out of the system. For this reason, the P concentration in the raw material should be high. Another non-volatile nutrient that might leak from the composting system is potassium.

The potassium content of the finished product must always be higher than that of the original raw manure. The use of compost typically has a positive impact on soil structure by lowering soil density as a result of the mixing of low density organic matter with the mineral soil fraction. The interactions between the organic and inorganic fractions have led to the detection of this beneficial effect in the majority of cases, and it is often accompanied by an increase in porosity (Amlinger et al., 2007).

According to Brown and Cotton (2011), soil bulk density followed a predictable trend, declining with higher composting rates. Low bulk density is a sign of increased pore space and better soil tillage. In this way, compost improves the aggregation and stabilization of soil, which was greatly sparked by a variety of soil organisms, increasing the amount of meso- and macro-pores (Liu et al., 2007). The organic portion of soils is also significantly lighter in weight than the mineral portion. Hence, as the organic content rises, the soil's overall mass and bulk density decrease (Brown and Cotton, 2011).

In the process known as "hot composting," aerobic bacteria break down and stabilize organic materials in an atmosphere with lots of air. For this procedure, it is necessary to maintain a specific oxygen content by mechanically ventilating the mixture and stirring in fresh air. Compost is created faster with aerobic treatment. Because it involves simpler technology and has a higher chance of being installed and run in developing nations, this recommendation concentrates on aerobic fermentation.

Temperature, oxygen availability, moisture content, pH, the C/N ratio, particle size, and the degree of compaction all have an impact on how well the fermentation process works (Onwosi et al., 2017). As necessary, moisture can be added and organic waste can be mixed to maintain and improve these characteristics (Getahun et al., 2012). Another efficient method for increasing aerobic fermentation is to blow or draw air into the bottom of the mixture. An anaerobic state develops when the moisture level is too high because it is unable to feed air

into the waste. Due to biological breakdown, organic components in the fermentation process are reduced to around 50% of their original amount, while fermentation heat-induced moisture evaporation lowers the raw materials' moisture content. Compost made from various organic wastes varies in quality and stability, which also depends on the composition of the raw materials used to make compost.

Effective composting often depends on a few variables that both directly and indirectly affect the microorganism's activities. They include the kind of source material that was composted, the nutrients it contained, the humidity, temperature, alkalinity, and aeration (Shyamala and Belagali., 2012). Co-compost cover materials can be made from a variety of off-farm leftovers and wastes, as well as crop residues, unused bedding materials, silage, manures, and similar on-farm products. The kind and thickness of the cover and base layer materials have a significant impact on the biodegradation of carcasses and the development and retention of heat that is required for pathogen inactivation because a mortality compost heap cannot be turned until the bio-decomposition of the carcass body has been substantially completed (Fonstad, TA et al 2003).

Huge garden residue is also generated in Duhok city and considered as one of the kinds of municipal solid residue because of its able to decompose organic fraction. To avoid the disposal of green residue by open burning, landfill and incineration site, it can be managing by fertilizer operation. Study to evaluate the achievement of composting garden residue (dry leaves) by using indigenous microorganisms in term of the fertilizer quality by (Siti Noor Baya Khalib et al, 2018)

A study was showed on the exploit of biomass organic residue in the shape of grass-clippings residue to make fertilizer. (Agustina\* and Sriharti April, 2020). The get rid of organic waste from timber manufacture has become an environmental problem for wood is the rising. Bio compost was made by fertilizer admixtures of urine and sawdust, sewage sludge and sawdust and cow dung and sawdust. According to Inbar et al. (1993), quality control during compost manufacturing should provide suitable chemical and physical qualities as well as a sufficient level of stability and maturity (Benito et al, 2003). In order to control the process in situ and make informed judgments regarding the process' performance, it is necessary to understand the physical and chemical characteristics of organic wastes and the variables that determine their performance in composting (Hurerta-Pujol et al, 2010).

Composted green waste typically contains reduced levels of heavy metals, which are frequently present in sludge-based composts, making them more environmentally friendly. However, the characteristics of yard waste will vary depending on the area's predominant vegetation and the time of year for its collection (Benito et al, 2005). The direct disposal of different organic waste will lead to significant environmental, health, and societal problems. It will also increase air pollution, cause a fly and odor problem, have an impact on water bodies when thrown into the water, and deplete the ozone layer when burned, which will have an increased impact on global warming and climate change. Composting is said to be the most environmentally beneficial method of getting rid of these wastes.

The main objective of this research was to evaluate the different organic residue available in local area in making four different hot compost during 18 days and to compare between these kinds in quality indices, to make an appropriate recommendation for compost making in this area, and also to study some physical and chemical properties of compost made of different row materials. These properties include: pH, EC, total organic carbon, total organic matter, total nitrogen, total phosphorus, total potassium, some soluble ions, C/N ratio, bulk density, moisture content, water holding capacity and porosity.

## 2. METHODS AND MATERIALS

### 2.1 Raw material and heaps mixture

Various heaps or piles of compost were made according to the Barkly method of hot composting during 18 days from the most available organic residues and wastes available in Duhok city which are, wheat hey and straw, brew garden leaves twigs, grass clipping brown, pine needle, carton board and papers, saw dust, sheep manure, chicken manure, fish meal and waste, slaughter waste, green grass clipping, sewage sludge, vegetable and fruit marketing waste. Then various types of compost were made from the most available organic residues and wastes in the Duhok city and comparison were made amongst their chemical and biological properties which enable making recommendation for farmers for best compost ingredients and these types include.

Heap 1. Wheat hey and straw + sheep manure + brown garden residue + chicken manure + fruit and vegetable scrapes.

Heap 2. Brown grass clipping + fish meal + pine needle + green grass clipping + vegetable and fruits scrapes.

Heap 3. Carton board and papers + slaughter waste + saw dust + brown garden residue + vegetable and fruit scrapes.

Heap 4. All material in aforementioned heaps were mixed in sequential.



**Figure 1: heap 1**



**Figure 2: heap2**





**Figure 3: heap3**



**Figure 4: heap4**

The study area was located at college of agricultural, in the Duhok province, Kurdistan region, North of Iraq. four heaps were prepared in college garden under pine tree, two heaps were constructed under pine tree in the college garden and another heaps under pin tree (Behind the Deanship Building) in the and compost samples were taken during composting and after maturation from each heap for biological, physical, and chemical analysis after air drying, then grinding and sieving with using (2) mm sieve and stored it in polyethylene containers in 4°C temperature.

### **2.1. Laboratory analysis.**

Compost pH and EC were analyzed in a 1:5 (v/v) (Compost: water) water extract using pH meter, and EC meter a glass electrode according to **(Rayment and Higginson, 1992)**. O.M (organic matter). Total organic matter was measured by combustion at 550 °C for 8 hours according to **(TMECC, 2001)**. Total Carbon. Total organic carbon (TOC) by the dry combustion method according to **(Abad et al, 2002)**. C/N Ratio (Chemical criterion to determine soil development).

### **2.2. Nutrient measurements.**

Total nitrogen. (TN) by Kjeldahl digestion **(Bremmer and Mulvaney, 1982)**. Phosphorus (P) was measured in total using the calorimetric method described by **Murphy and Riley in 1962**. In addition, soluble calcium and magnesium were measured in accordance with **Rowell (1996)**, while soluble potassium and sodium were tested in accordance with **Page et al. (1982)**'s approach for determining exchangeable calcium, magnesium, sodium, and potassium **(Hesse, 1972)**.

### **2.3. Physical properties.**

The water holding capacity (WHC) was determined. The formula for calculating the water holding capacity (g water/g dry material) is **(Ahn et al., 2008)**. Moisture contents (MC). In this study, moisture content (wet basis) was determined by drying at 105 °C for around 24 hours or at constant weight **(ASAE 1998, St. Joseph)**. Bulk density. Using a container with a capacity of about 10 liters, bulk density was calculated. To ensure there were no significant blank spaces, the material was placed in the container and then slightly compacted. By dividing the material's

weight by its volume in the container, the bulk density was computed in accordance with (Khater, 2015). According to the definition of porosity, it is the percentage of a soil's volume that is occupied by pores that contain both air and water (Nancy. and Marianne, 1997). Compost texture was calculated by sieving matured compost by 16 mm sieve, if more than 70% of compost remain in sieve, it considers as coarse mulch, if 20-70% remain in sieve, it considers as fine much, and if less than 20%, it considers as soil conditioner (Nancy et al. 1997).

#### **2.4. Heaps construction.**

By alternating between thin layers of "greens" and "browns," ingredients. Wet the compost pile well until it is saturated and oozing water from the bottom. To begin the composting process, place an activator in the center of the compost pile. Comfrey, nettles, yarrow, animal, fish, urine, or old compost are examples of activators. Day 4 after, flip the pile of compost so that the outside faces being in the interior and the inside faces the being in outside. To clarify further, when turning compost, place the exterior of the pile next to it and continue transferring material to the new pile from the outside. Everything that was inside will be outside after finishing, and vice versa. Make sure the humidity doesn't fluctuate. Put on gloves and squeeze a handful of the composted materials; there should only be a single drop of water released, or almost so. Spread it out if it gets too moist, use the handle of the pitchfork to make a 3-4" broad hole, or place sticks underneath for drainage. After Days 6 and 8, these days should see the compost heap reach its warmest point.

As a basic rule of thumb. If you can stick your elbow into the compost, it is not hot enough if it is not 50 degrees Celsius. Use a cake thermometer or a compost thermometer if possible. Ideal temperature is between 55 and 65 degrees Celsius. An anaerobic thermophilic composting bacteria that is sometimes mistakenly called "fire blight" grows throughout the compost at temperatures above 65 degrees Celsius. (It appears when the compost is oxygen-deprived and too hot—over 65 degrees Celsius.

When the temperature drops, aerobic composting bacteria take control and it vanishes. The temperature peaks between days 6 and 8 and progressively drops until day 18. Every other day, turn the compost pile over (on day 6 and again on day 8) There is too much nitrogen in the compost if the pile starts shrinking rapidly. Methane is released from the compost using this technology, the Berkley technique. Continue turning the compost every other day from day 10 to day 18 after that. Once DAY 18 has passed simple, warm, and pleasant to the smell. When earthworms enter the compost, a sign that it is finished and ready because it has cooled and is rich in nutrients (Atchley, K. 2013).

### **3. RESULT AND DISCUSSION**

Organic waste from plants, animals, or people is biologically broken down and stabilized during composting by a variety of microorganisms operating in an aerobic environment (Smith & Collins, 2007). The result of this biological process is a stable substrate that resembles humus and is devoid of pathogens and plant seeds. It can be used to improve soil or as an organic fertilizer on the ground. Even Nevertheless, historical practices like those of the Ancient

Egyptians or the Pre-Columbian Amazonian Indians imply that composting is an old technique for improving soil. (Haug, 1993).

As shown in table 1, the first heap that formed from Wheat hey and straw, sheep manure ,brown garden residue, chicken manure, fruit and vegetable scrapes, contains significantly the lowest value of soluble calcium  $6.46 \pm 0.29$  to  $6.93 \pm 0.48$  meq/l and potassium  $4.39 \pm 0.04$  to  $5.87 \pm 0.03$  meq/l, while has the same contents of soluble magnesium and sodium meq/l and the lowest EC values, these differences in studied parameters may attributed to the relatively long time spend in laboratory before being analyzed as it constructed firstly and may be due to the variability of chemical composition of raw materials of composting heap. The second heaps that formed from brown grass clipping, fish meal, pine needle, green grass clipping, vegetable and fruits scrapes is better than first heaps for their Ca and K content but have the highest value EC of  $2.66 \pm 0.02$  ds.m<sup>-1</sup> and this may return back to the presence of fish meal that contain high amounts of salts and minerals.

The use of compost with EC less than 2 ds.m<sup>-1</sup> can be used safely for all types of vegetables and crops and compost till 4 ds.m<sup>-1</sup> can be used safely for non-salt sensitive plants if added in moderate doses to the soil. (Abouhussien et al 2019) also found 4.80 meq/l Ca<sup>2+</sup>, 1.35 meq/l Mg<sup>2+</sup>, 0.20 meq/l K<sup>+</sup>, and 8.65 meq/l Na<sup>+</sup> in cold composting in Egypt for 60 days. The third heap which formed from carton board and papers, slaughter waste, saw dust, brown garden residue, vegetable and fruit scrapes and forth heap which is a mixture of three above mentioned heaps in sequential are supreme significantly in their content of almost studied parameters listed in table 1.

Especially forth heap is the best amongst the rest heaps because it contains wide range of organic materials from different sources which gives an indicate that the quality of compost is improved significantly, when the mixture of raw material is compost of large number of organic materials. Another important parameter of compost is pH. It is crucial for agricultural cultivation since many soil organisms and plants prefer slightly acidic or alkaline environments, which affects their vitality. The availability of nutrients in the soil is also impacted by pH. Due to its abundance in alkaline cations, such as Ca, Mg, and K, which were liberated from OM owing to mineralization, compost treatment exerts a liming impact (Agegnehu et al., 2014; Daniel and Bruno, 2012).

Similar to this, regularly applied compost material improves or maintains soil pH (Soheil et al., 2012; Jamal, 2009). After compost application, a pH drop was only sometimes noticed (Mohammad et al., 2004). Several references agree that the pH content of matured compost range between (5-8). As indicated in table1 the first, second, third and fourth heaps the pH in typical range of matured compost that is within the acceptable range, this result agree with Mehta and Sirari (2018), that found the pH value ranged between (6.0-7.5).

**Table 1: Soluble ions, pH and EC of the four studied heaps**

Heaps	Variables					
	Ca <sup>+2</sup> Meq/L	Mg <sup>+2</sup> Meq/L	Na <sup>+</sup> Meq/L	K <sup>+</sup> Meq/L	Ph	EC ds.m <sup>-1</sup>
<b>Heap1</b>	6.93±0.48 c	3.80±0.87 a	3.163± 0.05 a	4.39± 0.04 c	7.40± 0.08 a	1.49±0.01 d
<b>Heap2</b>	6.33± 0.13 b	5.66±0.37 a	3.283±0.01 a	5.10± 0.03 b	7.53± 0.005 a	2.66± 0.02 a
<b>Heap3</b>	6.80± 0.30 bc	5.40±0.64 a	3.08±0.20 a	5.13± 0.04 b	7.02±0.003 b	2.22± 0.01 c
<b>Heap4</b>	6.46± 0.29 a	4.13±0.29 a	3.043±0.08 a	5.87± 0.03 a	6.97±0.008 b	2.45±0.003 b
<b>ANOVA Summary P-Values</b>						
<b>P-Values</b>	0.559	0.140	0.495	0.000	0.000	0.000
Means with the same letter are not significantly different (Fisher's test, P<0.05). ± denotes standard errors of the mean total of each variable at each site						

The most important physio-chemical properties of matured compost are the content of organic matter and organic carbon because it considered the source of all other essential macro and micro nutrients and improve most soil chemical, biological and physical properties as cation exchange capacity, biodiversity and soil aggregation. Most references agree that the organic matter content of matured compost range between 30-70% but the percent between 50-60% is typical for using compost for different purposes as soil organic fertilizer, soil amendment and soil conditioner for bioremediation of contaminated soils (Crohn, D.M. 2016). As indicated from table 2, the content of organic matter is low only in heap 1 is low that may attribute to the dryness due to long duration before being analyzed, while the organic matter of the second and third heaps in typical range of matured compost that is suitable for all purpose, however fourth heap have the significant high organic matter due to much raw organic matter or it indicate that it still not decomposed completely and may require additional few days to be completely matured but still in allowable ranges that is less than 70% (Moore at al 2015).

The typical total nitrogen content of final matured compost ranges between 1-2.5 %, and as shown in table 2, the nitrogen of third heap is the supreme over the rest heaps, however the second and fourth heaps also contain satisfied contents of nitrogen that can be mineralized directly when added to the soil and supply plants immediately by nitrogen. The first heap nitrogen content is not in favorable values of matured compost due to its high dryness before being analyzed due to lack of chemical reagents and measuring instruments immediately, this result agrees with Jalal & Shekha (2019) that found the total nitrogen value of compost is 0.617 at Erbil city. The total phosphorus contents of matured compost by various methods is 0.3-0.9% and as indicate from table 2 the P range in all heaps are in allowable ranges, the fourth heap being the supreme on its total P contents, then second heap.

The P contents in four constructed heaps are sufficient to be used for adequate P supply for various plant growth. The average calcium content in compost ranges between 1.5-3.5%, however the first, second, and fourth heaps contains relative high amounts of calcium due to their mixes with bed soil that contain high amounts of calcium carbonate. The magnesium range in compost ranges between 0.25–0.7%, and as indicated from table 2, the Mg contents in all fourth compost heaps are relatively low and not different significantly. The most another important index of compost maturity is C/N ratio, typically the C/N of mature compost is below 20:1 that easily mineralize nitrogen when added to the soil, however the ranges greater than



12:1 up to less than 25:1 are allowable (Crohn, D.M. 2016). As shown the last three heaps are within the permissible limits of mature heaps, while the first heap is over allowable range as the nitrogen content is low due to the long period of dryness before being analyzed or the C/N ratio of composting raw material is less than 15:1 that increased after composting, and it also concluded that the all compost heaps are not phytotoxic as C/N ratio don't drop under 10:1 and the last three heaps are nematicides as the C/N ratio is around 20:1 that control almost plant pathogenic nematodes. (California Compost Quality Council 2001).

**Table 2: Organic matter and carbon, Total nitrogen, Phosphorous, Calcium, Magnesium, and C/N ratio of studied heaps**

Heaps	Variables						
	O.M g.kg <sup>-1</sup>	O.C %	Total N%	Total P %	Total Ca <sup>+2</sup> %	Total Mg <sup>+2</sup> %	C/N ratio %
Heap1	30.77±0.85b	17.30±0.50b	0.67±0.01c	0.63±0.008c	5.33±0.33ab	0.27±0.06a	25.65±1.2a
Heap2	52.45±0.47ab	29.13±0.26ab	1.42±0.05bc	0.75±0.03b	7.00±1.53a	0.30±0.05a	20.50±0.8a
Heap3	59.5±15.6a	33.05±8.67a	3.16±0.25a	0.47±0.02d	2.66±0.33b	0.28±0.09a	10.45±1.6b
Heap4	64.36±5.43a	35.76±3.02a	1.88±0.48b	0.85±0.0227a	6.00±1.00a	0.30±0.07a	19.02±5.3a
ANOVA Summary P-values							
P-values	0.083	0.087	0.001	0.000	0.056	0.977	0.022
Means with the same letter are not significantly different (Fisher's test, P<0.05). ± denotes standard errors of the mean total of each variable at each site							

The bulk density of compost is a vital physical property to evaluate the quality of compost, and how much their values are lower it indicates a good quality of compost as their ability to hold water and improve soil texture and soil aeration. And as shown in table 3, the bulk density ranges between 200±5- 470±10 kg.m<sup>-3</sup> of and the bulk density of third compost heap is significantly lower than the fourth heap which is significantly lower than first and second heaps. The raw material of third and fourth heaps are proven to improve all physical and chemical properties of compost that degrade rapidly and form fine lighter compost, however other researcher recorded ranges between 400 to 500 kg.m<sup>-3</sup> (Mohee and Mudhoo 2005) (Romeela et al 2008). The moisture contents of final matured compost ranges between 15.05±0.0% in first heap to 34.16±0.67 in third heap, this result agrees with Khater, (2015) that found the moisture content of compost between (23.5%-32.1%) however, the optimum recommended moisture content of compost should be between 40-60%. But because of hot dry local weather in the region the moisture contents of compost rapidly draw down and so effects negatively on nutrient and physical properties as well.

The porosity or interstitial space between particles of various constructed heaps ranges range between 59.20±0.7 to 68.29±0.86%, the normal ranges of compost porosity ranges between 50-70%. Generally, the compost porosity depends on the solid volume and moisture contents that inversely proportional with porosity. As revealed in table 3, the porosity of second heaps is significantly greater than the other studied heaps that were not different significantly. And it may be due to the nature of degradable organic material and relative small particle solid volume and typical moisture contents of 26%. The water holding capacity is also considered an important compost property because the retention of moisture in soil is highly improved by

adding compost as organic matter can retain about 9 times greater than their volume water and maintain soil moisture for long time to supply plants by adequate water and nutrients as well. As table 3 declare the water holding of all studied compost heaps are not differ significantly and all heaps retain water more than three times of their weight that may be more than six to seven time of their volume, these may be due to the same solid volume of studied heaps.

The volume of compost solid particles effects many other crucial compost physical properties, and as table 3 declare, the all studied compost heaps have approximately the same percent of solid volume ranges between  $22.50 \pm 0.2$  to  $27.03 \pm 3.02$  %. The final texture of finished matured compost by hot composting during 18 days is so fine to be considered as soil conditioner that improve almost soil chemical, physical, and biological properties of soil and even can be used for soil bioremediation from various contaminants. The size of compost particles was determined by sieving the compost by 16 mm sieve and the percent of all compost particles remain in sieve after sieving were much less than 20%, so the all compost considered as soil conditioner not as fine and course soil mulches. The percentage of compost remaining above the 16 sieve for each of heap 1, heap2, heap 3 and heap 4 respectively is 67.73%, 2.12%, 8.45% and 23.26% and so, it concluded that the compost of first heap texture is fine mulch, whereas the texture of last three heaps is soil conditioner.

**Table 3: Some physical properties of compost studied heaps**

Heaps	Variables					
	Bulk Density $\text{kg.m}^{-3}$	Porosity%	Moisture Content%	Water Holding Capacity g water/g dry matter	Volume of Solid%	Texture
Heap1	$440 \pm 10a$	$62.32 \pm 0.28b$	$15.05 \pm 0.06d$	$3.15 \pm 0.03a$	$27.03 \pm 3.02a$	Fine mulch
Heap2	$470 \pm 10a$	$68.29 \pm 0.86a$	$26.13 \pm 0.32c$	$3.13 \pm 0.03a$	$22.50 \pm 0.28a$	Soil Conditioner
Heap3	$200 \pm 5c$	$59.41 \pm 1.54b$	$34.16 \pm 0.67a$	$3.07 \pm 0.02a$	$23.30 \pm 0.65a$	Soil Conditioner
Heap4	$350 \pm 6b$	$59.20 \pm 0.75b$	$28.05 \pm 0.39b$	$3.06 \pm 0.01a$	$22.50 \pm 0.28a$	Soil Conditioner
<b>ANOVA Summary P-values</b>						
P-values	0.000	0.001	0.000	0.184	0.202	
Means with the same letter are not significantly different (Fisher's test, $P < 0.05$ ). ± denotes standard errors of the mean total of each variable at each site						

#### 4. CONCLUSIONS

The hot composting considers an efficient fast way for returning the organic municipal waste to valuable compost with high quality and nutrient content and free from pathogens and weed seeds as temperature of composting exceeded  $60^{\circ}\text{C}$  for more than one week. The almost utilized organic waste are obtained freely in this region and thrown to create more environmental and visual pollution, and can be invested commercially in small and large scale and providing hundreds of job opportunities for newly graduated not employed students from agricultural colleges. The third heap which formed from carton board and papers, slaughter

waste, saw dust, brown garden residue, vegetable and fruit scrapes is the best one for obtaining the high-quality rapid compost that is significantly greater than other heaps components, followed by forth heap which is a mixture of three heaps components in sequential is in their content of almost quality indicator. The dry hot weather rapidly draws down moisture content from finished matured compost, so it recommended to be stored directly in plastic bags or to been used directly as organic fertilizer for immediate soil fertilization and amendments. Also, it concluded that the use of slaughter waste produces pungent smell and attract flies, rodent, and reptiles as well as pathogens, so it recommended to be used for other purposes such the fodder of farm animals after proper processing.

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