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RESEARCH PAPER

Chemical and Biological properties of compost produced from house solid waste.

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A B S T R A C T:

The primary objective of this research was to investigate the chemical and biological properties of compost produced from different row materials. These materials are solid waste from organic houses, residues from plants, manure from animals, paper and grass. The process of composting to produce mature compost takes 30 days. Nevertheless, compost assessed chemical characteristics included: pH, EC, total organic carbon, total nitrogen, total phosphorous and organic matter. The pH value was near to neutral 7.3. Organic carbon content and organic matter content was 23 and 39.48 respectively.

The biological results reveals a total of 22 different species of fungi including: *Acremonium*, *Aspergillus*, *Cladosporium*, *Emricella*, *Eurotium*, *Fusarium*, *Geotricum*, *Humicola*, *Mucor*, *Penicillium*, *Stechybotrys*, *tetracoccosporium*, and *Thermomyces*, the result showed that the most frequently isolated fungi was Aspergillus spp. ($10*10^3$ CFU), especially Asp. niger which was ($6*10^3$ CFU), followed by Alternaria spp., which was ($4*10^3$ CFU).

KEY WORDS: compost, solid waste, species
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1.INTRODUCTION :

Municipal solid waste is becoming a critical issue in most of the world's megacities as the amount of waste continues to rise, resulting in resource depletion and increased environmental hazards (Atalia, *et* al., 2015). Most of these wastes (more than 90 percent) are used for unscientific landfilling and unregulated disposal in the outskirts of towns and cities with serious environmental effects on global warming (GHG emissions) (Saha et al., 2010). Composting is an aerobic mechanism in which microorganisms degrade and convert complex degradable materials into organic and inorganic byproducts.(Toledo et al., 2018) and (Ayilara et al 2020).

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Composting has become an increasingly important solution to the disposal of urban organic waste. Better understanding of the dynamics of the microbial community is needed to evaluate the system and end product quality (Steger et al., 2007). Composting is an economic and sustainable choice for handling organic waste, as the processing of a good quality product is fairly easy to manage properly. It is a technique that facilitates the reduction of mass waste leading to its stabilisation. (Ashrafi et al., 2014).

Compost quality is an important environmental variable correlated with the life, stability, nutrient content and other physicochemical and biological parameters of multiple inorganic and organic recalcitrant pollutants (Barral *et al.*, 2007). Composting is a promising source of new organisms and thermo-stable enzymes that may be helpful in environmental management and industrial processes. The process has raised much attention lately since it is also an environmentally sound method that avoids all pollution concerns. One of its benefits comes from its use in microorganisms to degrade organic waste into nutrient and produce organic fertilizer. (Tiquia-Arashiro, 2019)

Bacteria, fungi, actinomycetes, and animal materials, are organisms that perform a significant purpose in the composting method concerning their repetition.The biomass ratio in compost between the fungi and the prokaryotes is about 2:1.

Furthermore, compost existing fungi use various carbon origins, often lignocellulosic polymers can also thrive under intense situations, each of the primarily effective for the ripening of compost. Dominant in the composting process are the fungal genera (e.g., Aspergillus, Penicillium, Fusarium, Acremonlum, and Cladosporium). Fungi are an essential component of the microbiota recognized through composting because of their capacity to decay dry resistant acid and low-nitrogen holding substrates related to bacteria (Langarica-Fuentes, *et al.,* 2014).

Through effects of hydrogen ions on microbial system dynamics with an ideal pH range of 5.5 to 8, the pH affects the composting cycle. The soluble mineral content of the sample typically consists of cations, Na+, K+, Ca2+, Mg2+ and anions, HCO3-, Cl-and SO4 2-(Vázquez *et al.,* 2015). The investigation aimed to know the fungal populations in the production of windrow compost. Therefore, reusing the solid waste as natural soil fertilizers.

2.Materials and Methods:
Sample collection and Analysis:

The experiment was conducted at the University of Salahaddin at the glass house, Salahaddin. Most organic waste is used in compost processing, such as cow manure, herbal plant residues and household solid waste. Homogenisation and airing of composting content was done by periodic turning (Leege and Thompson, 1997). Within 30 days of turning the whole waste into manure, the experiment was conducted.

The chemical and biological characteristics used in compost processing. PH, EC, TOC, TP, TN and OM are the chemical properties. The pH was measured using the pH meter and the EC meter tested the electrical conductivity. Walkely Black approach was used to calculate TOC. Compost samples of total organic nitrogen was determined by Micro-Kjeldhal method. Total phosphorous determined using ammonium molybdate with $Sncl_2$ method (Ashrafi *et al.,* 2014).

Fungi were isolated using three media (PDA and SDA incubated at temperatures (25 and 37 ℃). The identification of fungi was performed by means of analysis of macroscopic and microscopic characteristics of colonies Identification, based on morphology characteristics included colony pigmentation, texture, and growth rate and distinctive morphological structures, depending on Keys on: (Moubasher, 1993 and Watanabe, 2002).

3.Results and Discussion:

During this analysis, after 30 days, mature compost was produced as dark brown color the figure (1). pH during the mineralization reaction may be 7.3 due to the production of ammonia (Zameer et al., 2010). Mature compost's electrical conductivity is 18.35 mS / cm, which can be attributed to the use of high amounts of vegetable waste. The increase in EC quality may be caused by the release of mineral salts such as phosphates and ammonium ions by organic material decomposition (Fang and Wong, 1999).

The overall organic carbon decline was 23 percent during the sample compost, which is consistent with these findings (Cabrera et al., 2005).reported that part of the carbon is lost due to the evolution of CO2 and the remaining loss is due to assimilation of carbon by the microorganisms. Total phosphorus content was 0.53% can be attributed to the decomposition of solid wastes (Elango et al., 2009). The total nitrogen content in the compost samples was 2.48 percent, the highest content of Nitrogen as obtained in case of studied compost might indicate higher fixation of atmospheric N within compost heap during composting process (Seal *et al.,* 2011). Organic matter is the measure of carbon based materials in the compost. Organic matter is an important ingredient in all soils and has an important role to play in maintaining the soil structure, the supply of nutrients and the capacity to hold water. The total organic matter content of the compost specimens was 39.48 percent, which was found to be within the normal range. (table 1). High quality compost will usually have a minimum of 50 % organic content based on dry weight (Mondini et al., 2003).

This result shows the qualitative and quantitative composition of the mycoflora of prepared compost, These results reveals a total of 22 different species of fungi including: *Acremonium, Aspergillus, Cladosporium, Emricella, Eurotium, Fusarium, Geotricum, Humicola, Mucor, Penicillium, Stechybotrys, tetracoccosporium,* and *Thermomyces* genera have been isolated and identified which belongs to Ascomycetes and Zygomycetes, the result showed that the most frequently isolated fungi was *Aspergillus* spp. (10 CFU), especially *Asp. niger* which was (6 CFU), followed by *Alternaria* spp., which was (4 CFU). These results is agreement with found by (Anastasi, *et al*., 2005) who isolated Most of the 66 species common to both green and vermicompost composts belong to the *Acremonium, Aspergillus, Cladosporium, Malbranchea, Penicillium, Pseudallescheria* and *Ther- momyces* genera, this due to the composting materials content, also to thermo tolerance and/or capacity of the isolated fungi to degrade a wide range of organic waste (Miller 1996). Ramadan and Ismael (2011) were stated that the higher rate of isolated fungi were: *A. niger, Alternaria sp., S. brevicaulis, A. tamarii, and Mucor* sp. The mature samples had observed a heavy presence of Aspergillus fumigatus. So the high temperatures formed the mycobiota during the maturation of the compost. Under these especially hostile conditions only some specific organisms can survive and reproduce Piazza, *et al.*, (2020).

The enzyme activity of cellulose, produced by bacteria and fungi, is the main cause of carbohydrate and cellulose degradation. The soil physical components as moisture content, texture, and structure, which affect soil aeration, have a intense impact on fungal activity, The water content of soils affects microbial activity not only directly but also indirectly by affecting the diffusion of gases that may result in a shift from aerobic to anaerobic metabolism Kamel, *et al.*, (2014), Atlas *et al.*, (1998) and Griffin, *et al.*, (1963).

Piazza, *et al.*, (2020) some thermophilic fungi can develop enzymes such as amylase, xylanase, phytase, and chitinase, like Thermomyces dupontii (=Talaromyces thermophilus), Thermomyces lanuginosus, degrading woody components in the compost. However, the samples also found opportunistic pathogenic species.

The enzyme activity of cellulase which produced by bacteria and fungi, is the main causes of carbohydrate and cellulose degradation, The soil physical factors as moisture content, texture and structure, which affect soil aeration, have a profound influence on fungal activity , The water content of soils affects microbial activity not only directly but also indirectly by affecting the diffusion of gases that may result in a shift from aerobic to anaerobic metabolism (Kamel, *et al*., 2014, Atlas, R. M. and Bartha, 1998 ; and Griffin 1963).

Table 1: Chemical characteristics of study compost.

Parameters	Compost
pH	7.3
EC (mS/cm)	18.35
TOC%	23
T.Phosphorous%	0.53
Total Nitrogen%	2.48
Organic Matter %	39.48

4.Conclusions:

An experimental study was carried out successfully to discover the chemical and biological properties of compost. These obtained results indicate that the pH value was 7.3, and EC values were 18.35 mS/cm for compost. The total organic carbon values 23. Results showed good chemical and biological properties because rapid decomposition of compost increasing the amount of total organic carbon and organic matter. Also, that amount of organic matter related directly with numbers of fungi in the compost.

High biodiversity of Fungal species belonging to Ascomycetes and Zygomycetes were identified during the composting process. The highest rate of *Aspergillus* spp. Especially *Asp. niger*, which among the isolated fungi, among isolated fungi: *A.fumigatus* and *Asp. flavus* are human pathogens and can origin serious diseases, Chrysosporium sp. is of significant importance, which is keratinophilic and have a role in the degradation of keratin, Thermomyces sp. also of significant important during composting that decay the woody constituents in the compost.

Table 2: Chemical parameters quantity in three different time of composting

Parameters	10th day	20th day	30th day
Ph	7.3	7.7	7.8
EC (ms/cm)	18.35	17.33	15.12
TOC%	23	22	20
T.Phosphorous%	0.53	0.42	0.25
Total nitrogren%	2.48	3.22	4
Organic matter%	39.48	34.23	32.12

Table3: Frequency distribution and percentage of fungal species in terms of the days of sampling of the compost.

Fungi	1	2	3	Total CFU	Percentage%
Acremonium spp.	1		1	**2**	**4.25**
Alternaria sp.	1	2	1	**4**	**8.51**
Aspergillus flavus	1	1		**2**	**4.25**
Aspergillus fumigatus		1		**1**	**2.12**
Aspergillus niger	3	2	1	**6**	**12.76**
Aspergillus ochraceus		1		**1**	**2.12**
Chaetomium spp.	1	2		**3**	**6.38**
Chrysosporium spp.		1		**1**	**2.12**
Cladosporium spp.	1	2		**3**	**6.38**
Cunninghamella sp.		1		**1**	**2.12**
Emericella nidulans	1		2	**3**	**6.38**
Eurotium sp.	1	1		**2**	**4.25**
Fusarium oxysporum		2	1	**3**	**6.38**
Geotrichum sp.	1	1		**2**	**4.25**
Humicola sp.		1		**1**	**2.12**
Mucor spp.		1	1	**2**	**4.25**
Penicillium ssp.	1			**1**	**2.12**
Stachybotrys sp.			1	**1**	**2.12**
Tetracoccosporium sp.		1		**1**	**2.12**
Trichoderma sp.	1		1	**2**	**4.25**
Thermomyces sp.			1	**1**	**2.12**
Mycelia sterilia	2	1	1	**4**	**8.51**
	15	**21**	**11**	**47**	**100%**

Figure (1): Mature compost.

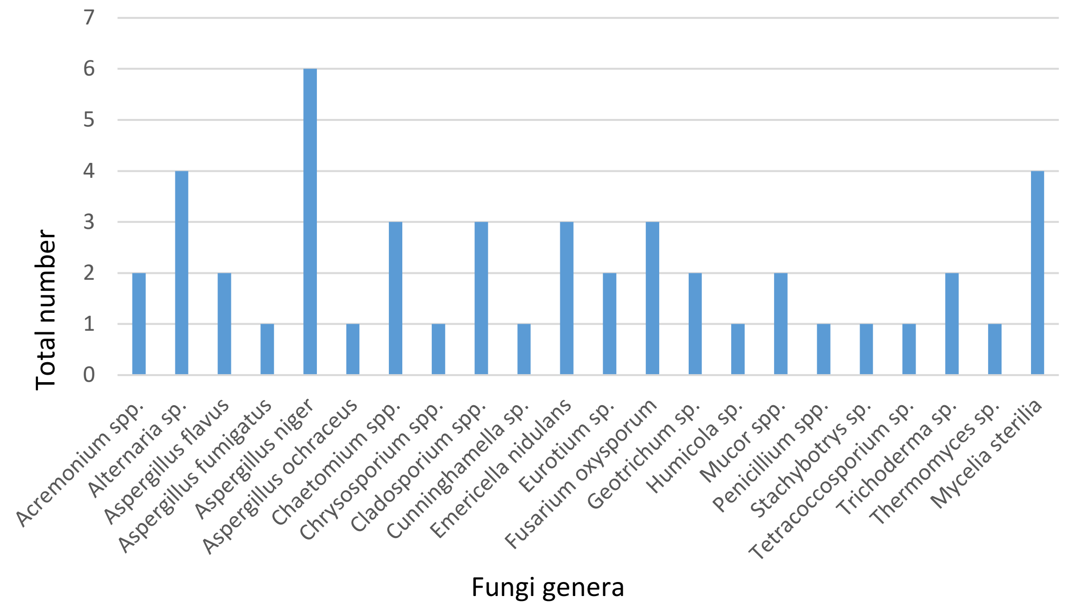

Figure 2: Total number of fungi species in the studied compost

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