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Biotic Factors Involued in Organic Recycling Matter Evaluating the Efficiency of Some Nanocomposites Different Paints

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Abstract

The study was conducted in the laboratories of the Department of Life Sciences, College of Education for Girls. It is one of the modern studies on recycling organic waste, represented by the leaves of various plants. The treatment unit was represented by a basin for recycling plant leaves, prepared for this purpose. The recycling stages were monitored by taking samples weekly until the organic decomposition process was completed, in addition to biological tests such as measuring the vital factors represented by bacteria, fungi, and cocci bacteria participating in the decomposition and recycling process. The study demonstrated the role of microorganisms in the biodegradation process, represented by bacteria at the beginning of organic decomposition and the beginning of the decomposition of organic matter. Their percentage increased after the fourth week of the process, then gradually decreased with the end of the decomposition process and the decrease in temperature. As for fungi, their percentage was low in the fifth and sixth weeks of organic decomposition, but at the beginning of the decomposition process they were present but in large numbers. Bacillus bacteria appeared at the beginning of the organic decomposition process and appeared in large numbers at the beginning of the fourth week of the process, and the percentage decreased in the sixth and seventh weeks of the organic decomposition process with the decrease in temperature. As for the organic matter, its percentage was measured from the beginning of decomposition until the end of the decomposition.

Keywords: Organic Decomposition, Recycling, Biotic Factors

Introduction

The importance of recycling has recently become clear, after the awareness of the danger of environmental pollution, that the efficiency of the recycling process is of great importance, as it clearly contributes to the preservation of natural resources. With the increase in the rate of waste, the idea of recycling has spread and crystallized and has become an essential part of society to preserve the built environment on a sound basis and its survival and continuity in a clean and acceptable manner.

The recycling of organic matter and its decomposition into nutrients for decomposing organisms through the process of biological biodegradation (Masciandaro et al., 2013). Biodegradation means the decomposition, breakdown, and breakdown of organic matter into elements and minerals (Doukani et al., 2022). Decomposition is carried out by groups of different organisms, including bacteria, fungi, and bacilli, which secrete vital extracellular surface enzymes that facilitate the decomposition process. They are assisted by worms,

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insects, and other organisms that feed on dead organic matter. Decomposition occurs aerobically in the presence of oxygen (Vance, 2022).

Requirements for decomposing microorganisms

Nutrients: Nutrition Material

Microorganisms that decompose and break down organic matter found in plant leaves and other types of waste and participate in decomposition need organic carbon.C and other nutrients such as phosphorus, nitrogen, potassium, sulfur, magnesium, sodium and other trace elements, and carbon is needed 25 times more than nitrogen to maintain nutritional balance, and the most important element among these elements is nitrogen N, and nitrogen N is the most important and necessary element in building amino acids, proteins and nucleic acids (Maret & Blower, 2022). If the decomposition is fast and the heat generated is high, it causes the loss of nitrogen N in the form of ammonia gas with its unpleasant, repulsive smell and nitrite oxide to the atmosphere (Goyal et al., 2005).

Heat: Temperature

The activity of microorganisms that decompose organic matter and their role in decomposition depends on many climatic factors, including temperature. The increase in temperature resulting from the increase in the speed and rate of chemical and enzymatic reactions increases the activity and effectiveness of these organisms (Othman, 2016). The most suitable temperature for activity and decomposition is between 15-45 degrees Celsius. Thus, the activity of decomposing organisms increases, and the temperature gradually rises with the increase in the activity of microorganisms and the increase in the decomposition of organic matter, eventually reaching approximately 35-65 degrees Celsius (Danco, 2016).

Humidity: Moisture

Water and moisture are important nutrients that decomposing microorganisms need. They are a good medium for chemical reactions and important in the movement of decomposing organisms. When the fermented materials are saturated with water, fermentation is successful and good, in addition to oxygen and others (Alramli & Alkurtany, 2022).

The best percentage of humidity that should be available for the decomposition of organic matter and for the activity and effectiveness of microorganisms is between 40-60%, as this percentage is sufficient to maintain the activity of decomposing microorganisms. If the percentage of humidity is less than 40%, the decomposition process slows down and the rate of the process decreases. If the humidity is more than 60%, the decomposition process approaches anaerobic decomposition (Arafa, 2003).

Ventilation and oxygen: Ventilation

Vital activities such as respiration and metabolism of aerobic microorganisms, which are fungi, bacteria and filamentous organisms that decompose organic matter, require oxygen to carry out the oxidation process.Oxygen is an important element within the decomposition pile. It can be provided by continuous and regular stirring. If its percentage decreases to less than 10%, anaerobic organisms will prevail in the process and the process will be anaerobic fermentation, causing the emission of gases such as methane and hydrogen sulfide, which produce unpleasant, undesirable odors and increase the acidity of the medium, in addition to the emergence of pathogenic organisms with the continuation of the fermentation process (Al-Duri, 2023).

Methods

Materials and working methods: Materials and Methods

This study was conducted at Tikrit University - College of Education for Girls - Department of Life Sciences - Tikrit University. The work and preparation period for the experiment lasted from December 2024 to March 2025 for the purpose of recycling and organic decomposition of plant leaves.

This method is considered one of the best ways to treat the environment effectively and safely, with equipment and supplies.

Table 1. Laboratory Equipment and Materials Inventory: Source and Country of Origin

Japan	Various food media	1
China	nylon cover	2
China	distilled water	4
local	Petri dishes	5
India	Laboratory glassware of various shapes and sizes	6
China	Various laboratory materials (picrates and tubes)	7
China	1 inch plastic pipes	9
local	1 wooden basin	2
China	sensitive balance	3
China	Regular scale	4
India	sitter	9
Germany	Quebec colony counter	10
Germany	The strawMicro pipette	11
India	Hood device	17
Jordan	electric oven	18
India	burning furnace	19

Microbiological assessment: Microbiology assessment

Preparation of dilutions of decomposed organic matter: a) Ten-fold dilutions were prepared by taking 1 gram of the decomposed organic matter and placing it in 9 ml of distilled water at a concentration of 0.9% until it reached the seventh dilution; b) Tests were conducted for each of the following dilutions, for the purpose of cultivating them in the appropriate agricultural media. Dilutions of distilled water 3, 4, and 5 were chosen for each of the bacteria, and dilutions 5, 6, and 7 for fungi, and 4, 5, and 6 for filamentous bacteria; c) Sterile Petri dishes were prepared for culturing microorganisms. 1 ml of each dilution was added to them and poured into the prepared culture medium while stirring in a circular motion and gently. The sample was mixed with the culture medium until it solidified. The dishes were poured and cultured inside the device.Hood to prevent any contamination of the food medium; d) The agricultural environment was incubated as follows: 1) Bacteria dishes were placed in an incubator at 37°C for 24 hours; 2) The fungal dishes were placed in an incubator at 25°C for up to a week; 3) Plates of filamentous bacteria were placed in an incubator at 28°C for 14 days.

The number of microorganisms growing in the agricultural media was estimated using a microbiology counting device according to the method ofQuebec colony counter (American Public Health Association, 1985).

Method of estimating organic matter

Dry burning methodDry Combustion: 1) A sample of 50 grams of fermented organic matter was taken and weighed on a sensitive four-stage balance; b) The sample of fermented organic matter was dried in an oven at 70°C for 24 hours to remove moisture content and then weighed; c) The fermented and dried organic material sample was burned in an incinerator at 450°C for 2 hours and the weight was extracted.

The percentage of total organic matter (%) is calculated according to:Klute, 1986) and by the following law:

$$\text{TOM} = \frac{\text{Mo} - \text{m2}}{Mo - M1} \times 100$$

Weight of ash = Weight of the trough with the sample after incineration - Weight of the empty trough.

M0: Weight of empty eyelid.

M1: Weight of the lid with the sample when dried.

M2: Weight of the eyelid with the sample after burning

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Results and Discussion

Microorganisms that contributed to the decomposition process:

There are many microscopic organisms during the different stages of the organic decomposition and recycling of plant leaves, which have been proven to play a major role in the success of the process. Tests were conducted to determine the numbers of these microscopic organisms and the percentage of organic matter from the beginning of organic decomposition until the end of the process, as follows:

Total bacteria

The study showed that the number of bacteria at the beginning of decomposition was low, as the number of bacteria in the decomposition tank was recorded at 20*-5 10 cells/g. In the second and third weeks, the percentage rose higher, as the number of bacteria contributing to the decomposition process increased, recording 32*-5 10 and 40*-5 10, respectively. The number of bacteria contributing to the decomposition process continued to rise, especially in the fourth week, reaching 75*-5 10. The numbers decreased in the sixth and seventh weeks, respectively, 60*-5 10, 55*-5 10. The decomposition process by bacteria during the recycling stage was carried out by more than one type of bacteria. With the rise in temperature and the continuation of decomposition, the temperature decreased and the number of bacteria decreased due to the decomposition of organic matter and the consumption of nutrients available in the medium by bacteria due to their microbial activity (Gautam et al., 2010).

Table 2. Number of bacteria x5-10 contribute to the organic matter recycling process basin.

The seventh week	Week 6	Fifth week	Fourth week	The third week	The second week	First week	Date of taking Sample Type of decomposition
55	60	66	75	40	32	20	organic decomposition

Bacteria

The number of spore-forming bacteria at the beginning of decomposition was low. The number of bacteria recorded in

The decomposition basin in the first week was 30*-5 10 cells/g, and in the second and third weeks the percentage rose higher as the number of bacteria contributing to the decomposition process increased, recording 37*-5 10 and 48*-5 10 respectively. The number of bacteria contributing to the decomposition process increased, recording 66*-5 10 in the fourth week, and decreased in the sixth and seventh weeks, reaching 55*-5 10, 40*-5 10 respectively. The number of bacilli increased with the rise in temperature, and with the decrease in temperature, the number of bacilli decreased. The increase in the rate of biodegradation was through the increase in the number of microorganisms, which had an impact on the path of completing the process in terms of the speed of decomposition, time, and the decrease in unpleasant odors (Labouri, 2023).

Table 3. Number of bacilli ×5-10 contributing to the organic matter recycling process basin

The seventh week	Week 6	Fifth week	Fourth week	The third week	The second week	First week	Date of taking Sample Type of decomposition
40	55	60	66	48	37	30	organic decomposition

FungiFung

The study showed a decrease in the number of fungi in the last weeks of the organic decomposition process and in the decomposition tank, as they reached 80* -103, 88* -103 cells/g, in the fifth, sixth and seventh weeks respectively. Thus, the number of fungi decreased gradually with the continuation of the decomposition process and during the advanced weeks of the decomposition process. The percentage and number of fungi were high in the first weeks of the decomposition process compared to the advanced weeks of the process, as they reached 189* -3 10 cells/g, 245* -3 10, 220* -3 10 respectively.

Fungi need organic carbon to live, as they use it in their nutrition. Fungi can tolerate unfavorable conditions and use many sources of organic carbon, thus preventing the accumulation of organic materials such as tree and animal skeletons (Miller, 1996).

Fungi are used in the biological treatment of contaminated soil. Fungi play a major role in breaking down and analyzing complex organic materials such as cellulose into simpler materials.

The reason for the increase in the number of fungi in the first weeks is the acidity of the mixture and the generation of organic acids, which are considered stimulants for the growth of fungi and organisms that decompose cellulosic materials, and at the same time inhibit the growth of bacteria. The decrease in the number of fungi in the last weeks is attributed to the low concentration and percentage of organic matter with the continuation of the decomposition process (Gallardo & Nogales, 1987).

Table 4. Temporal Analysis of Organic Decomposition Processes: A Seven-Week Study

The seventh week	Week 6	Fifth week	Fourth week	The third week	The second week	First week	Date of taking Sample Type of decomposition
	88	98	120	220	245	189	organic decomposition

Organic matterOrganic Materials (OM)

The results showed that the organic matter values at the beginning of the decomposition of the experimental basin reached (2.33, 2.45, 2.66, 2.25) % in the decomposition period for the last four weeks in a row, while the first weeks recorded (3.4, 3.45, 3.18). The reason for this decrease in the organic matter values of the beehive basin is the consumption of organic matter due to the activity of microorganisms, which work to convert organic carbon into carbon dioxide gas and water to obtain energy (Jawhar, 2010).

Table 4. Analysis of Decrease in Organic Decomposition Rate in Weekly Time Frame

The seventh week	Week 6	Fifth week	Fourth week	The third week	The second week	First week	Date of taking Sample Type of decomposition
2.25	2.45	2.66	2.33	3.18	3.45	3.4	organic decomposition

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