



# Decomposition by Microorganisms and Its Role in Ecosystem Function

Ryan Joseph\*

Department of Environmental Microbiology, National Life Science University, Pune, India

## DESCRIPTION

Decomposition is a biological process through which dead plants, animals, and organic residues are broken down into simpler substances. It occurs continuously in forests, agricultural fields, grasslands, freshwater environments, and soils. Microorganisms such as fungi and bacteria perform much of this work by using organic materials as sources of energy and nutrients. Decomposition is essential for the continued movement of elements through ecosystems because nutrients contained in dead organisms are returned to soil, water, and the atmosphere.

Decomposition begins with physical and biological changes. Dead material may be fragmented by insects, earthworms, termites, and other soil organisms. Fragmentation increases the exposed surface area and makes the material easier for microorganisms to colonize. Rainwater can also remove soluble compounds from plant tissues. Microorganisms then consume available compounds and release enzymes that break down more complex substances. The remaining material becomes progressively more altered and eventually contributes to soil organic matter.

Different organisms participate in decomposition at different stages. Soil animals may chew and fragment dead leaves, while fungi and bacteria consume dissolved and solid organic compounds. Protozoa and nematodes feed on microorganisms and contribute to the transfer of microbial nutrients through the soil food web. Larger organisms such as earthworms mix organic residues with soil particles, creating conditions that support further microbial activity. Decomposition is therefore the result of interactions among many organisms rather than the activity of one microbial group.

Carbon cycling is closely associated with decomposition. Plants remove carbon dioxide from the atmosphere during photosynthesis and convert carbon into organic compounds. When plants die, microorganisms use these compounds as energy sources. Carbon is then released partly as carbon dioxide

during microbial respiration. Under oxygen-limited conditions, some carbon may be converted into methane or remain stored in organic materials. The balance among these processes affects the amount of carbon retained in soils and released into the atmosphere.

Nitrogen cycling is another important aspect of decomposition. Dead plant and animal tissues contain nitrogen in proteins, nucleic acids, and other molecules. Microorganisms break down these compounds and release nitrogen-containing substances. Organic nitrogen can be converted into ammonium through mineralization. Other microorganisms may then transform ammonium into nitrite and nitrate. Plants can absorb these inorganic forms of nitrogen, making decomposition an important process for maintaining soil fertility.

Decomposition also occurs in aquatic environments. Dead algae, aquatic plants, leaves, and animal remains enter rivers, lakes, wetlands, and oceans. Microorganisms colonize these materials and break them down. In streams, leaf litter from surrounding vegetation can become an important food source for aquatic organisms. In lakes and wetlands, microbial decomposition influences oxygen levels and nutrient availability. Excessive amounts of decomposing organic matter can consume dissolved oxygen and create conditions that are harmful to aquatic animals.

Decomposition has practical importance in waste management. Organic waste represents a large portion of municipal and agricultural waste streams. Biological treatment through composting and other microbial processes can reduce waste volume and produce useful organic materials. Anaerobic digestion is another process in which microorganisms break down organic matter in the absence of oxygen and generate biogas containing methane and carbon dioxide. The remaining material can sometimes be processed for agricultural use.

## CONCLUSION

Decomposition is an essential biological process that transforms

**Correspondence to:** Ryan Joseph, Department of Environmental Microbiology, National Life Science University, Pune, India, E-mail: ryan.j@researchmail

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dead organic materials into simpler substances and returns nutrients to ecosystems. Fungi, bacteria, soil animals, and other organisms work together to break down leaves, wood, animal remains, crop residues, and organic wastes. The process influences carbon, nitrogen, phosphorus, and sulfur cycles and supports soil fertility and ecosystem productivity.

Decomposition also has practical applications in composting, waste treatment, agriculture, and biotechnology. Understanding the microorganisms and environmental factors involved in decomposition can support better soil management, organic waste processing, and conservation of natural ecosystems.