

Research in Microbiology a Key Fact

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Received date: August 09, 2021; **Accepted date:** August 23, 2021;
Published date: August 30, 2021

Introduction

Microbiology is the study of microscopic organisms, such as bacteria, viruses, archaea, fungi and protozoa. This discipline includes fundamental research on the biochemistry, physiology, cell biology, ecology, evolution and clinical aspects of microorganisms, including the host response to these agents. Roots of different plant species are colonized by distinct microbiota, even when grown in the same soil. A comprehensive combination of experimental manipulation of plant species, plant mutations, plant signalling, community composition and order of community application reveals how community assembly differs among plant species. Plants interact with a multitude of soil microorganisms, ranging from pathogenic to mutualistic species and strains. Different plant species have distinct root microbiota¹, but the mechanisms underlying root-associated microbiota assembly remain largely mysterious. Several processes may contribute to the observed variation in community structure, including local adaptation, bacteria–bacteria interactions, or neutral processes. The existence of microorganisms was predicted many centuries before they were first observed, for example by the Jains in India and by Marcus Terentius Varro in ancient Rome.

The first recorded microscope observation was of the fruiting bodies of moulds, by Robert Hooke in 1666, but the Jesuit priest Athanasius

Kircher was likely the first to see microbes, which he mentioned observing in milk and putrid material in 1658. Antonie van Leeuwenhoek is considered a father of microbiology as he observed and experimented with microscopic organisms in the 1670s, using simple microscopes of his own design. Scientific microbiology developed in the 19th century through the work of Louis Pasteur and in medical microbiology Robert Koch. While some fear microbes due to the association of some microbes with various human diseases, many microbes are also responsible for numerous beneficial processes such as industrial fermentation (e.g. the production of alcohol, vinegar and dairy products), antibiotic production and act as molecular vehicles to transfer DNA to complex organisms such as plants and animals. Scientists have also exploited their knowledge of microbes to produce biotechnologically important enzymes such as Taq polymerase, reporter genes for use in other genetic systems and novel molecular biology techniques such as the yeast two-hybrid system. A variety of biopolymers, such as polysaccharides, polyesters, and polyamides, are produced by microorganisms. Microorganisms are used for the biotechnological production of biopolymers with tailored properties suitable for high-value medical application such as tissue engineering and drug delivery. Microorganisms are for example used for the biosynthesis of xanthan, alginate, cellulose, cyanophycin, poly(γ -glutamic acid), levan, hyaluronic acid, organic acids, oligosaccharides polysaccharide and polyhydroxyalkanoates. Microorganisms are beneficial for microbial biodegradation or bioremediation of domestic, agricultural and industrial wastes and subsurface pollution in soils, sediments and marine environments.

The ability of each microorganism to degrade toxic waste depends on the nature of each contaminant. Since sites typically have multiple pollutant types, the most effective approach to microbial biodegradation is to use a mixture of bacterial and fungal species and strains, each specific to the biodegradation of one or more types of contaminants. Symbiotic microbial communities confer benefits to their human and animal hosts health including aiding digestion, producing beneficial vitamins and amino acids, and suppressing pathogenic microbes. Some benefit may be conferred by eating fermented foods, probiotics (bacteria potentially beneficial to the digestive system) or prebiotics (substances consumed to promote the growth of probiotic microorganisms). The ways the microbiome influences human and animal health, as well as methods to influence the microbiome are active areas of research.