Journal of Complementary Medicine Research, ISSN: 2146-8397 Vol. 14, No. 4, 2023 (pp. 52-56)

RESEARCH ARTICLE WWW.JOCMR.COM

A Microbiology That Focuses on Medicine in Addition to The Study of Other Applications of Microbiology

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ABSTRACT

The field of microbiology investigates life forms that are too tiny for the naked eye to detect. Any living entity that is too tiny for the naked eye is considered a "microorganism." Microbial ecology, molecular biology, immunology, industrial microbiology, and biotechnology are only few of the newer branches of microbiology that have emerged during the last 150 years. All of these emerging areas of study in microbiology have helped push the subject forward. Microbes come in different forms and sizes and may be found in the three spheres of life (Bacteria, Archaea, and Eukarya). Microorganisms, by a wide margin, are the most common form of life on Earth. Microorganisms including bacteria, archaea, protists (including protozoa and algae), fungi, helminths (parasitic worms), and viruses are all instances of biological agents. In addition, there are helminths and parasitic worms to consider. Protists are not limited to protozoa or algae, but also include bacteria and archaea. Most microbes are helpful, such as those that assist in purifying water and growing certain foods. Many of these creatures are also important to the smooth functioning of the global environment. Though certain bacteria may be harmful to the health of some plants and animals and even contribute to the development of serious diseases in humans, the vast majority are very important for the proper functioning of the ecosystem that exists on our planet.

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How to cite this article: Tripathi K A, Bhaskararao P, Antony R A, Sakale S S, Soni R, Verma S, Keshamma E, Pawar D Y, Sharma S, Malik A (2023) , A Microbiology That Focuses on Medicine In Addition To The Study of Other Applications of Microbiology. Journal of Complementary Medicine Research, Vol. 14, No. 4, 2023 (pp. 52-56)

INTRODUCTION

Studies of the microbial diversity of soil and water, in addition to the metabolic processes something which microorganisms carry out in these habitats, expanded the scope of microbiology as it entered the twenty-first century from its approach focusing on fundamental principles, and methods, but instead medical aspects. This expansion occurred as the field entered the twenty-first century. This development took place when the twenty-first century got underway in the sector. (Diez-Pascual & Rahdar, 2022) Two well-known microbiologists who were active throughout that time period are called Martinus Beijerinck as well as Sergei Winogradsky, respectively. The most significant contribution that Bierock made was the development of the approach known as enrichment culture.

KEYWORDS:
Microbiology,
Biotechnology,
Immunology,
Industrial microbiology

ARTICLE HISTORY:
Received: Apr 20, 2023
Accepted: May 24, 2023
Published: Jun 28, 2023

DOI:
10.5455/jcmr.2023.14.04.11

This is a technique in which extremely selective nutrient but instead incubation conditions are employed to isolate microbes from their natural environments. These microbes are chosen because their metabolic processes and other properties have become best suited to the conditions used, thereby giving them an advantage over other organisms. By using this method, Beijelick was able to successfully isolate the first pure cultures of a large number of the common soil and aquatic microorganisms that we are familiar with today. (2022)

OBJECTIVE

The research aimed to fulfill the following objectives:

- To study medical microbiology
- The applications and uses of microbiology in the healthcare system
- Prospect and scope of microbiology

METHODOLOGY

The study of microbiology had rapid growth during the 20th century, paralleling the proliferation of highly advanced laboratory equipment that became accessible during this time period. During this time period, the field of microbiology developed into a mature scientific discipline, giving rise to a number of new subfields with their foundations in genetics and molecular biology. Most contemporary studies of microbes are motivated by genomics studies that map, sequence, and analyze genes and genomes. New and improved techniques for deoxyribonucleic acid (DNA) sequencing, along with powerful computational analysis, are being used to solve some of the most intractable issues in health, agriculture, and the environment today. These techniques have also shown the vastness and remarkable variety of the microbiome. Together with a core set of techniques developed by microbiologists over through the years, modern molecular microbiologists are on the cusp of a profound understanding of cellular processes. Through this increased knowledge, people will be better equipped to control the negative effects of microbial activity and take use of its positive aspects. But before they analyze any one of these processes, it is important to first examine the major divisions of the microbial world and their similarities and differences.

Medical Microbiology

Although the great majority of microbes are helpful to humans, there is a small percentage of species, less than one percent, that are pathogens and have the potential to cause damage. The disease develops when a pathogen is able to effectively infect its host, multiply inside it, and then cause harm to the host. There are two ways in which pathogens may cause harm to the host: toxicity and invasiveness. Multiple infections create toxins that are harmful to humans and in some cases may even be fatal to them. Once a pathogen has established itself inside its host, it will begin to emit certain poisons, which are referred to as exotoxins. Endotoxins, on the other hand, are found in the cell's outermost layer, which is referred to as the cell wall. Exotoxins produced by bacteria are some of the most powerful toxins ever discovered. For instance, the amount of botulinum exotoxin required to kill an adult person is just 1 ng (one-millionth of a gram). To learn more, check out these related articles: Molecular Mechanisms of Botulinum Toxin and Toxin Action Invasive infections are harmful to the host because they may destroy tissue or deplete vital nutrients. Cellular appendages like fimbriae and pili aid in bacterial attachment to host cells, the first step in the invasion process. Enzymes such as leucocidins and collagenases may be responsible for tissue degradation. White blood cells and indeed the protein filaments collagen, present in many connective tissues, are broken down by these enzymes. Capsules are the thick polymer coatings that certain bacteria produce outside of own cell walls. These capsules protect the invading virus from the host's immune response. "(Tripepi, 2022)" In response to the presence of harmful bacteria or poisons, hosts generate antibodies that attach to and neutralize the invaders, and they also gather white blood cells to either consume the invaders or produce poisonous chemicals to destroy them. In addition to increasing antibody production, the existence of toxins triggers a state of hyperarousal in the host. Check see Bacterial Capsules and indeed the Avoidance of Immune Responses and Bacterial Pili with Fimbriae while you're at it. In humans, infectious diseases most often enter via the lungs, mouth/gut, skin, or genitourinary systems. The skin and the genitourinary system are other potential entryways. Some diseases, such as those that are sexually transmitted (like gonorrhoea and syphilis) or those that are spread via the air (like the common cold), may be transferred from one person to another through the presence of a pathogen (such as TB and influenza). Occasionally, infections are transmitted from susceptible hosts to those other susceptible hosts via intermediary hosts, such as vectors (animals that carry germs from vulnerable hosts towards other susceptible hosts) or inanimate objects (such as clothing or towels). Similarly, the deer tick and indeed the Anopheles mosquito are the only known arthropod vectors for Lyme disease and malaria, respectively. Once a pathogen has infected a vulnerable host, the incubation period begins. This is the phase when the pathogen grows and takes hold in the host. Symptoms of a sickness don't show up until the incubation period is through. Syphilis: Epidemiological Components; Tuberculosis; Malaria; Respiratory System: Bacterial Infections are some further resources. Antibiotics are compounds produced by certain microorganisms that impede the development of bacteria and other infectious organisms. Antibiotics are often recommended because they may help noninfectious bacteria and kill or inhibit infectious ones. These results are accomplished by interfering with cellular metabolism, damaging the plasma membrane, inhibiting the creation of cell walls, or affecting the synthesis of nucleic acids or proteins. Viral replication can only occur inside a host cell; thus, antibiotics have no impact on them. Consequently, different chemical compounds are required to cure viruses, either by inhibiting viral enzymes or by altering viral nucleic acids. Resistance to antibiotics has emerged in bacteria in recent years due to their extensive usage in both humans and animals. Humans aren't the only species to experience this phenomenon; animals have experienced it too. Medical professionals have a lot to worry about since these germs are resistant to antibiotic treatment. In the battle against microbe-borne diseases, vaccines are a potential supplementary strategy for avoiding the initial establishment of infections in the body. To wit: (Kniert et al., 2022) Vaccines protect people against disease-causing microorganisms and other harmful foreign antigens by encouraging the body to produce antibodies against them. Diphtheria, whooping cough (also called pertussis), poliomyelitis, measles, among mumps are all preventable diseases thanks to vaccines.

The Applications and uses of microbiology in the healthcare system

- A VACCINE is a biological preparation that is designed to enhance an individual's immunity against a certain illness. Vaccines often consist of weakened or destroyed versions of the bacterium that causes the illness, as well as one of the bacteria's surface proteins or toxins. Vaccines also include an agent that is similar to the microorganism that causes the disease. The agent causes the immune system of the body to get activated, causing it to detect the agent as a foreign invader, kill it, and "remember" it. This allows the immune system to more readily recognize and eliminate any of these germs that it meets in the future. (Kumar et al., 2019)
- ANTIBIOTICS Antibiotics are substances that have the ability to kill bacteria and other microorganisms with similar structures or to restrict their development. Fermentation is the method that is used in the manufacturing process to create them. During this procedure, the source microbe is grown in big containers that contain a liquid growth medium. Antibiotics are the products of bacteria' secondary metabolic processes. Example: Penicillin, TETRACYCLINES
- VITAMINS Vitamins are organic compounds that are produced naturally by microorganisms. Vitamins play a crucial role in the metabolic processes of all living things. Microbial fermentations are the primary source of vitamin B12 and vitamin B2 (riboflavin), both of which are water-soluble vitamins. (2022)
- AMINO ACIDS: The L-forms of amino acids are the ones that are most often generated by microbial processes. Researchers discovered that Corynebacterium glutamic is an exceptionally effective source of L- glutamic acid. Corynebacterium, for instance, is responsible for the production of the amino acids L-aspartic acid and L-alanine. • L-CYSTEINE • L-TRYPTOPHAN
- STEROIDS: Steroids are hormones that are released by the adrenal cortex. They are important for the control of the metabolic processes that are involved in the processing of carbohydrates and minerals. Cortisone is used as an anti-inflammatory medication, the menstrual cycle regulators integrated into the "pill" for contraceptive usage, and as a postoperative immune response suppressor in organ transplant patients. It is also used to regulate the menstrual cycle.
- PROBIOTICS: Probiotics are living microorganisms that are marketed with the idea that they give health advantages when ingested, often by enhancing or repairing the flora that is found in the gut. Although lactic acid bacteria (LAB) and bifidobacterial are the sorts of microorganisms that are used as probiotics the most often, various yeasts and bacilli may also be utilized. Fecal transplants, in which the faces of a healthy donor are transferred to an infected patient in the form of a suppository, are another method for providing probiotics to the recipient.
- ENZYMES Enzymes are a kind of protein that, when present in a live creature, cause the pace of a chemical process to accelerate. An enzyme is a protein that speeds up certain chemical processes by converting a predetermined group of reactants, known as substrates, into a predetermined assortment of products. (Moscovici & Balas, 2022)
- Enzymes are very important catalysts for the metabolic events that take place in living things. Microorganisms that are capable of producing enzymes are used by many industrial sectors in order to accomplish various business goals. Industries modify the genetic material of certain bacterial genera, such as Bacillus, Clostridium, and Pseudomonas; fungal genera, such as Aspergillus, Trichoderma, and Penicillium; and actinomycete genera, such as Streptomyces and Cellulomonas, in order to get them to produce greater quantities of the enzymes in question.
- DEXTRANS Dextrans are a kind of polysaccharide that are made up of glucose molecules. Certain lactic acid bacteria belonging to the family lactoba lactobacillus are responsible for the production of dextran from sucrose. It is used as a blood volume expander during the process of blood transfusion, when dextran is used. It does not cause pyrogenic (i.e., elevated body temperatures) or allergic responses, and it will stay in circulation for a sufficient amount of time to provide time for protein replacement in the blood plasma. It is largely innocuous.
- BACTERIOCINS Bacteriocins are peptides that can be created more easily than tiny molecules. They are potential substitutes for traditional antibacterial chemicals. Bacteriocins have a variety of applications in the medical field as possible medicinal agents. Small-molecule bacteriocins, also known as microcin’s and antibiotics, have properties that are comparable to those of traditional antibiotics. They are often administered topically or via the digestive system. (Steven, 2022)
- MEDICAL DEVICES: Microbiology plays a key part in the development of medical devices, such as fluorescence fusion, which are used for the rapid and accurate identification of pathogens in tissue samples.

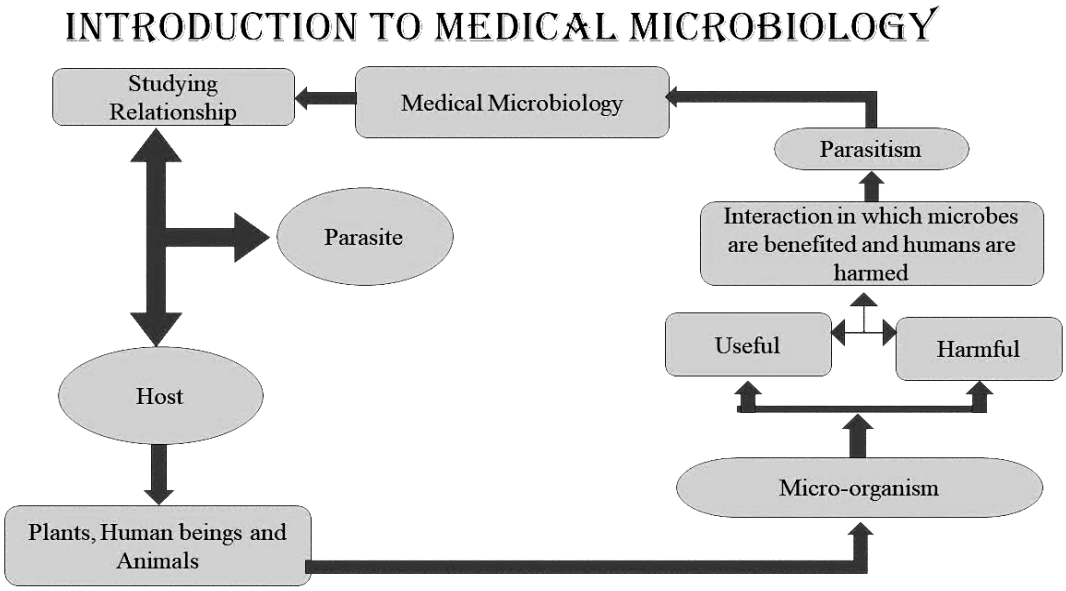

Figure 1: Medical Microbiology

Propspect And Scope Of Microbiology

The Prospects for Microbiology

- In the future, we will face problems such as discovering innovative methods to fight illness, cut pollution, and provide food for the world's population.
- HIV/AIDS, various forms of viral and bacterial hemorrhagic fever, and other infectious illnesses
- Make new medications and vaccinations. To find solutions to the issues, molecular biology and rDNA methods should be used.
- Relationships between hosts and pathogens
- Investigate the function of microbes as potential sources of high-quality food and other useful goods, such as enzymes with potential industrial applications.
- Reduce the amount of pollution and hazardous waste.
- In addition to their role as disease-treating vectors, they also boost agricultural output. (Jafri & Singh, 2022)

Microbiology's Wider Sphere of interest

- Microorganisms may be found in almost every environment on earth, including people, animals, plants, and other living beings, as well as in the atmosphere, water, and soil.
- Microbes are able to reproduce in all three environments, with the exception of the atmosphere. The sum of their numbers is significantly more than that of any other kind of living cell on our planet.
- Microorganisms are important to each and every one of us in a variety of different ways. The effect of microorganisms on human existence may be helpful at times, but it can also be harmful at other times.
- For instance, the manufacture of bread, cheese, yoghurt, alcoholic beverages, wine, beer, antibiotics (such as penicillin, streptomycin, and chloromycetin), vaccines, vitamins, and enzymes, as well as the production of a great number of other essential goods, all require the presence of microorganisms. (2022)

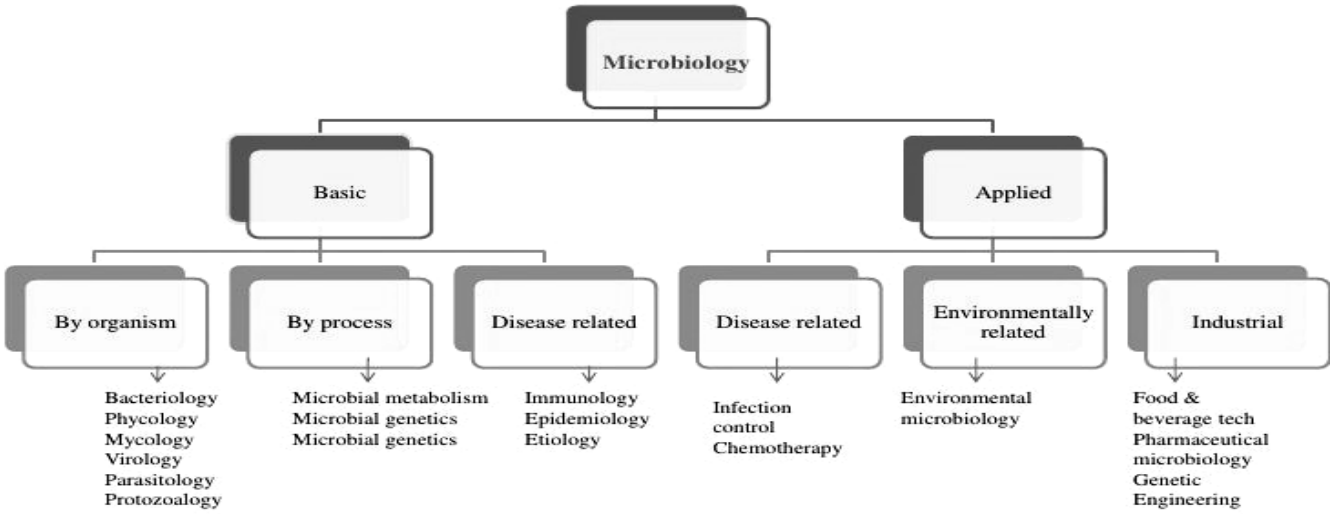

Figure 2: Applications And Uses Of Microbiology

CONCLUSION

Microbiology is the scientific study of organisms too small for the naked eye to see, such as bacteria, protozoa, fungi, and other similar organisms. The urge to learn more about these tiny organisms arose when scientists discovered a connection between them and certain diseases. Several significant discoveries, including as vaccines and other forms of medical equipment, have been made possible by the contributions of microbiology to the growth of the healthcare sector, notably the pharmaceutical and medical industries. New microbiological methods emerged at the same time as the rapidly growing cosmetics industry, paving the path for what is today known as cosmetic microbiology. When our bodies detect an invasion by foreign pathogens, they activate our innate defense systems, which manifest as pus formation and wound inflammation. The ability of macrophages to eat bacteria and other pathogens that enter the body via cuts and scrapes makes them a crucial aspect of the immune system. The rapid adaptation and mutation of bacteria, on the other hand, may cause opportunistic infectious diseases like HIV. However, there are many ways in which microorganisms may be useful to humans. One example is the function that the "good bacteria" lactobacillus plays in the human digestive system.

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