**Putting Bacteria to Work**

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Putting Bacteria to Work

Earth comprises of comprises of various elements, including living and nonliving components, that facilitate the survival of organisms and sustain ecological cycles. As part of the planet’s environment, humans actively and inactively participate in the ecological cycles that involve the recycle of resources that sustain life. It is vital for humans to understand ecological processes from the microorganism level to the physical environment to build sustainable structures that will promote rather than destroy the ecological system. It is for this reason that scholars have invested in the study of microorganisms to assess their functions and determine how to can optimize their use to improve life. The study of microorganisms traces its roots to the 1860s Louis Pasteur, Robert Koch, and other scholars identified bacterial pathos and established microbiology laboratory approaches that inform infection prevention and control today (Marco, 2020). Today, microbes permeate people’s lives, with their ability to metabolize elements helping in the management of waste, preparation of food, manufacture of pharmaceuticals, and production of fuel.

**Waste Management**

Microbes play an essential role in keeping landscapes clean due to their ability to metabolize elements. Khan (2019) claims that some microbe can degrade all naturally-occurring organic compounds. For synthetic compounds, such as plastics, Teflon, insecticides, and pesticides, microorganisms might take a long time or fail to break them down. Microbes break down organic molecules through the metabolic procedures of respiration and fermentation, which facilitates their transformation to CO2 and return to the atmosphere. In this regard, microbes keep landscapes clean because their activities in the carbon cycle allow them to break down components in the ecosystem. These activities facilitate waste management in diverse sectors, including sewage treatment facilities, compost, and landfills. In these situations, microorganisms digest organic materials into substrates, which eventually transform to carbon dioxide and organic acids.

Sewage encompasses a mixture of different types of wastes, which comes from sink, bath, toilet, and rain water. With increased growth of urban centers and industrial activities, there is need for a cost-effective waste management system to ensure that harmful materials do not overwhelm the ecosystem. Gupta et al. (2016) claim that diverse microorganisms, such as bacteria and fungi, are essential for bioremediation due to their ability to detoxify or biodegrade substances. Bioremediation encompasses the use of microorganisms to neutralize harmful waste or reduce their toxicity. Common microbes that help in biotransformation include *Azatobacter, Flavobacterium, and Arthrobacteriu.* Others, such as *Pseudomonas,* degrade monoaromatics, alkanes, and naphthalene under aerobic conditions. In this regard, microbes help in sewage management because they degrade compounds in water, eliminating their toxicity through their aerobic respiration activities before release to rivers.

**Food Microbiology**

Microbes do not just assist the body to break down food, they also help industries produce nutrients. On most occasions, information regarding microbes and food focus on the negative effects of the microorganisms, such as food poisoning, while overlooking their benefits to humanity. Khan (2019) claims that without the activities of microbes, food manufacturers could not make cheese, bread, chocolate, or beer. Kumar (2016) adds that humans have used bacteria and fungi for hundreds of years to produce drugs, foods, and chemical products. Additionally, the use of microorganisms for fermentation of food traces its roots to the Neolithic period. In the first step of food fermentation, manufacturers introduce microbes as an energy source together with other nutrients (Hanlon & Sewalt, 2020). The next process is refinement, which entails the separation of the food substance from the microbe. After this recovery phase, the preceding step encompasses purification to allow the removal of byproducts of the fermentation process.

Moroever, microorganism help produce compounds that help manufacturers modify consumables to optimize their benefits to humanity. Hanlon and Sewalt (2020) claim that microbes have greatly contributed to the development of food enzymes that have diverse roles in the food production industry. For instance, manufactures use these enzymes to reduce the content of lactose in foods, strengthen dough in baking, refine vegetable oil, produce coffee, convert starch into sugar, and hydrolyse proteins. With the help of microbes, humans have been able to stop food spoilage as well as give it a good taste and smell (Kumar, 2016). Among the microbes that assist in food fermentation include *Lactobacilli,* which helps in fermenting dairy products, such as cheese and yogurt, vegetables, such as olives, meat, and sourdough bread. Therefore, microbes have an indispensable role in the food industry ranging from production to digestion of nutriments.

**Industry Microbiology**

Health care is among the industries that have greatly profited from the discovery of microbes and developments in microbiology. Their main contribution in healthcare has been in the production of medicine, with breakthroughs that have eliminated disease threats worldwide. The antibiotic production industry is an excellent example of how microbes contribute to healthcare (Kumar, 2016). With the use of microbes, Alexander Fleming discovered Penicillin in 1928, which later led to massive improvements in antibiotic manufacture. Today, microorganisms help produce secondary metabolites and biosynthesis as well as facilitate drug biosynthesis. Khan (2019) asserts that the global annual sales of pharmaceutical drugs that arise from microbe activities is more than $13 billion. Microbes do not only help in waste management and food industry; they are also vital in health care and have helped improve public health over the years.

Additionally, microbes have gained popularity in the development of biofuels as an alternative to energy derived from fossil fuels. Kumar (2016) claims that natural fuel resources are experiencing a rapid decline, promoting research on bio-fuels. While natural fuels have greatly contributed to the development of humanity, their extensive use proves detrimental to the planet and all its inhabitants. Increased population growth has raised demand for fuel, straining the limited natural resources and raising climatic concerns. In response, some governments have invested in biofuels to reduce their dependence on natural resources. Microbes are central in the production of biofuels because they help break down organic compounds. Through the years, microorganisms have assisted organizations in developing bio-ethanol from starch, cellulosic ethanol from agriculture waste, and biodiesel from vegetable oils.

**Microbiology Field with the Potential for Further Development**

Among these applied microbiology fields, I find the conversion of waste products into fuels to be the most interesting area because it supports global environmental conservation efforts. There is a growing global concern toward the use of petroleum products due to their negative impacts on the environment. Particularly, scholars associate petroleum products to global warming that has contributed to climatic changes. There exists substantive literature that explores the negative effects of global warming, including insect outbreaks, wildfires, decreased water supplies, increased floods, reduced and decreased agricultural yields. In this regard, I find conversion of waste products into fuels to be of interest because it promises to offer a solution to the global warming problem facing the planet. Success in this field could help mitigate issues that threaten the existence of humanity, including climate change and greenhouse gasses.

The field entailing the conversion of waste products into energy has the potential for further development due to its environmental sustainability and affordability. For instance, the Microbial Fuel Cell (MFC) system is a promising technology that uses microbes to transform chemical energy into electricity (Chaturvedi & Verma, 2016). The system facilitates the use of microorganisms to convert chemical energy resulting from the oxidation of compounds into ATP through the transfer of electrons to terminal electron acceptors that generate electricity. The MFC system is a cheap source of electricity because it can use wastewater to generate power. While generating electricity, it also facilitates the treatment of wastewater. Despite promising benefits in environmental sustainability, conversion of waste products into fuels still lacks enough support from governments. This field has the potential for further development because investing in the industry could lead to the generation of more power output while preserving the limited natural resources.

In conclusion, microorganisms are an inseparable component of people’s life today due to their indispensable role in waste management, food microbiology, and industry microbiology. Microbes play a significant role in waste management because their ability to metabolize elements helps keep landscapes clean and treat wastewater. Additionally, they are essential in food microbiology because they not only help the body digest some foods, they also assist manufacturers in fermenting and modifying foods to optimize their nutrient content. In healthcare, microbes have been central in medical breakthroughs that have reduced the burden of diseases on society. Moreover, the ability to synthesize compounds has made microorganisms a potential solution to the energy problem facing the planet.

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