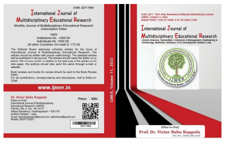
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ROLE OF MICROBIOLOGY IN FOOD INDUSTRIES AND PHARMACEUTICAL

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Abstract

Anatomy and physiology of organisms that are too small to be seen by the human eye are studied in the field of microbiology. At different stages of the food production process, different microbes are added to achieve the desired impact. There are a variety of pharmacological and medical goods that can be made using microorganisms. When it comes to the safety and quality of food products, microbiology plays an important role. Bacteria, mold, and yeasts are all types of microbes that are commonly used in the manufacturing of food and food ingredients like wine, beer, bakery goods, and dairy products. Conversely, food deterioration and pathogenic microbe development and contamination are two of the most common causes of food loss today. Microbial growth and contamination remain a problem even with the use of modern technologies and hygiene strategies, as well as traceability.

Keyword: Microbiology, Food, Pharmaceutical, Vaccine, Yeast.

Introduction

It was in the early 17th century that the microscope came into being, and microbiology was born. Girolamo Fracastoro's idea of contagious diseases in the 16th century laid the groundwork for the study of infectious diseases. Microorganisms such as viruses, bacteria, fungi, and plasmodia have been studied in greater detail in modern times. [1]

Sustainable agriculture relies on biotechnology, the most renowned and rapidly expanding branch of biological sciences. Sustainable agriculture relies heavily on the use of biotechnology - derived derived pesticides, fertilizer, herbicides, and insecticides, all of which have been developed utilising microorganisms. Microbial fermentation is also used to produce a number of other important food items. Microbes are added to food at various points in the food manufacturing process in order to achieve the desired results. [2] Many different pharmaceutical and therapeutic goods can be manufactured using pharmaceutical microbiology. Microbes employed in agriculture, food, and pharmaceutical industries are covered in this review article.

An understanding of microbiology and human cell mechanics helps pharmacists identify antimicrobial medications that could prevent an ever-growing variety of communicable illnesses. It takes the combined efforts of pharmacists and microbiologists to ensure that pharmacological treatments target opportunistic microorganisms while causing no harm to the human host. Microbes, such as Bacteriorhodopsin, a protein from Halo bacterium salinarum's plasma membrane, play a significant part in pharmaceutical research as well. [3]

Microorganisms

Almost every natural process relies on microorganisms. Even in extreme environments like hydrothermal vents and volcanoes, microorganisms constitute a vital part of life's web. Because of their role in the biosynthesis of oxygen and Carbon dioxide, microorganisms also have a role in fixing nitrogen in our environment so it can be utilised by a wide variety of organisms. [4] In addition, being a component of the animal's gut microbiota, they aid in digestion. In nature, there are symbiotic microbes. Bacteria and archaea are thought to number at about 1030 in the earth.

Microbes in pharmaceuticals

The discovery of penicillin and the creation of antibiotics in the early 20th century and the discovery of an efficient vaccine against smallpox in the 19th century are examples of early achievements in the area of medicine that exploited microbes. Over half of the pharmaceuticals available today are derived from natural sources. About 42% of the most popular pharmaceuticals in 1997 were derived from naturally occurring substances. [5] The pharmaceutical business makes extensive use of the tens of thousands of secondary metabolites already known to science. All across the world, antivirals, antibiotics, and antifungals are routinely utilised in healthcare settings. Medical products and services that incorporate the use of bacteria have four separate components: (1) biocontrol of illness, (2) vaccine production, (3) antibiotic production, and (4) biotherapeutic production (hormones, biomaterials, and others). [6]
Antibiotics

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As an antimicrobial agent, antibiotics are capable of preventing the growth or killing of microbes, including bacteria and fungi. Microorganims manufacture these components, which have antimicrobial activities, to combat the growth of microbes. Penicillin, a fungus from the Penicillium genus, is one of the most commonly used antibiotics today because of advances in medical science. [7]

Probiotics

Supplements with favourable effects on the host's microbial balance, such as live bacteria or other microorganisms, may also be employed [39]. A single microorganism secretes these substances, which stimulate the growth of other microorganisms. Lactic acid bacteria and biofidobacteria are the most often employed probiotic bugs. Probiotic active live cultures are added to yogurt, soy yoghurt, and dietary supplements. [8]

Microbes in the food industry

Microbes have been used in the food industry from the beginning of time. Bread, yogurt, cheese, kombucha, preserves, and preserved meats, as well as alcoholic beverages, all benefit from the chemical reactions that bacteria facilitate. As part of the microbiome, microbes also play an important role in the gut, which has led to new strategies for designing microbiome-friendly foods. Food safety, design, quality, and shelf-life are all improved by techniques to prevent pathogenic microorganisms from contaminating food. Antimicrobial food packaging is a relatively new food industry innovation. [9]

It is possible that microorganisms can play two different roles in food production today. First and foremost, they serve as fermentation starters (in this case, GMOs or engineered microorganisms are not allowed). In addition, they serve as production facilities for the manufacture of food ingredients. As the world's population grows, so does the need for new foods. It is possible to augment basic diets with protein by using SCP (single-cell protein), which is derived from cultured microbial biomass and thus lower than conventional protein sources. Animal and human foods both employ SCP as a protein source. [10] An extensive variety of Bacillus and Hydrogenomonas bacteria have been employed as substrate for the commercial synthesis of sulphur because of their high crude protein content (up to 80 % by dry weight). Saccharomyces, Candida, and Rhodotorula are the most commonly employed yeasts for the production of SCPs. Because yeasts can grow on so many different kinds of food, it's easier to utilise this method, but the resulting SCPs are lacking in sulfur-containing amino acids. Filamentous fungi include Fusarium, Aspergillus, and Penicillium, and prokaryotic algae include Spirulina, which contains around 65 % protein by dry weight. [11] It has revived the food processing sector, which sees new possibilities for traditional meals, such as flavours, textures, and aromas, or even the discovery of new foods, as a result of the use of microorganisms.

Review of Literature

Yeast and natural yeast traits have been altered through genetic engineering to enhance fermentation performance. It will soon be possible to have superior quality breads and pastas in a shorter period of time. Yeasts have been enhanced to withstand temperature and pH changes and to grow at a high rate on a wide variety of substrates (Linko et al., 1997). [12]

A better sensory experience can be achieved by selecting yeasts that produce β-lyase, which enhances aromatic thiol release and, in turn, the aroma of the wine (Belda et al., 2016) [13], while the selection of yeasts that specialise in specific processes such as flocculation can help improve the fermentation of specialised wines like sparkling wines (Tofalo et al., 2016) [14]. Non-Saccharomyces strains, which were previously considered minor or undesirable yeasts, have had a positive impact on the vinification process due to their ability to produce enzymes, secondary metabolites, glycerol, ethanol and other compounds that can enhance the wine's organoleptic complexity (Padilla et al., 2016) [15].

Functional foods are increasingly being made with strains of both genera, which were traditionally used to make fermented dairy products. There has been a growth in probiotic meals and beverages on the market, as well as a growing number of non-dairy probiotic beverages (Enujiugha and Badejo, 2017). [16]

Food preservation has been an essential part of humanity's survival from the beginning of time, ensuring the safety and stability of various foodstuffs. Traditional food preservation methods like salting, drying, fermentation, and heating are still widely used in the modern food industry today. Since then, we've learned a lot more about what causes food to degrade and become contaminated, which has resulted in lower losses (Gram et al., 2002). [17]

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Objectives

- To study the role of microbe in food and pharmaceuticals
- To study the role of bacteria in insulin production
- To study source of poribiotics and its effect on body
- To study role of microbe in vaccine production

Research Methodology

In the world of academics, methodology refers to the systematic, theoretical examination of the procedures used in a particular area of research. It is the study of a field's set of methods and principles from a theoretical perspective. Parameters like paradigm, theoretical model and phases are typically included in this type of research. In the current study, secondary data was acquired from a number of sources, including books, educational and development periodicals and government publications as well as printed and online reference resources.

Result and Discussion

Industrial microbiology is a subfield of applied microbiology that focuses on the use of microorganisms in the production of critical items such antibiotics, food, enzymes, amino acids, vaccines, and specialty chemicals. As demonstrated in Figure 1, microbes are critical to industrial processes. [18]

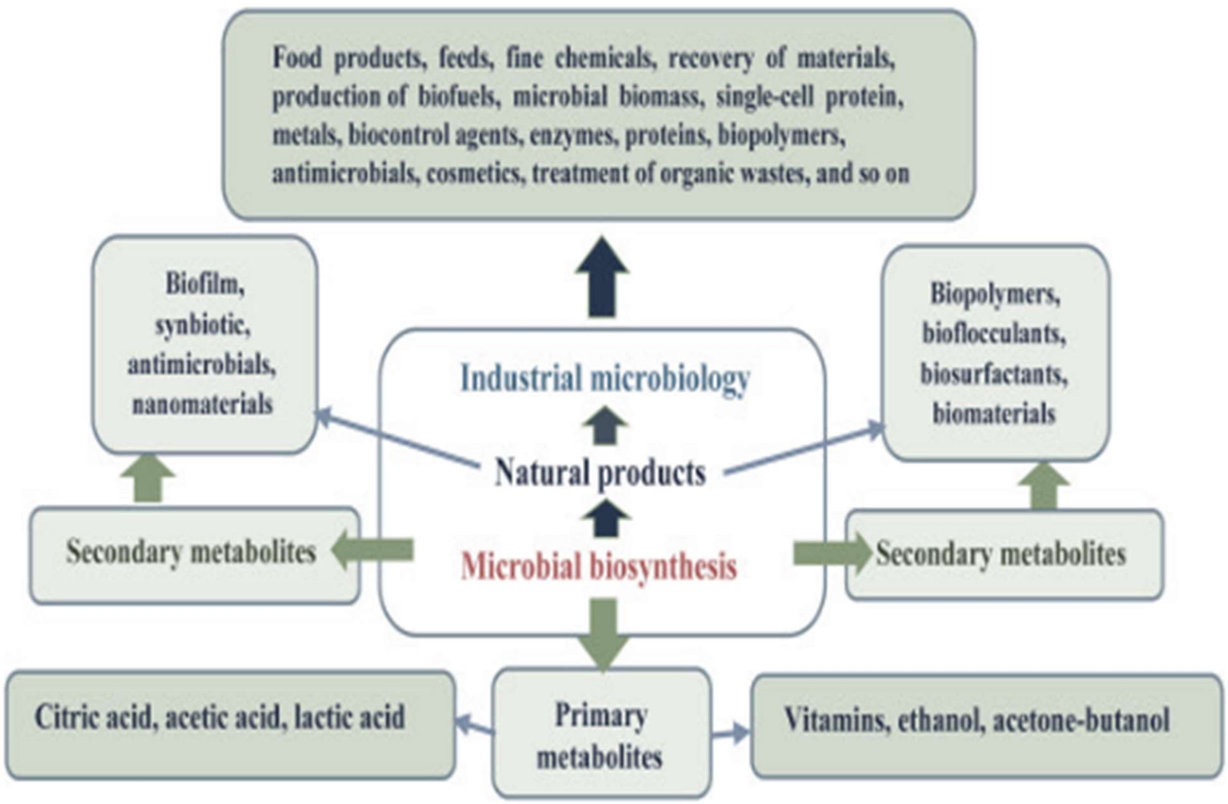

Fig. 1 A Systematic Diagram Shows the Importance of Microbial Synthetic Metabolites in Different Industrial Fields.

When it comes to vaccine manufacture, microorganisms aren't used as biofactories at all, but rather to promote the synthesis of certain antibodies (either in whole or in fractionated form). Vaccines can be classed into (A) attenuated or live, (B) inactivated (subdivided into B1 – whole or fractionated, B2 – subunit vaccines, B3 – toxoids, B4 – carbohydrate vaccines, and B5 – conjugates), (C) DNA vaccines [19]

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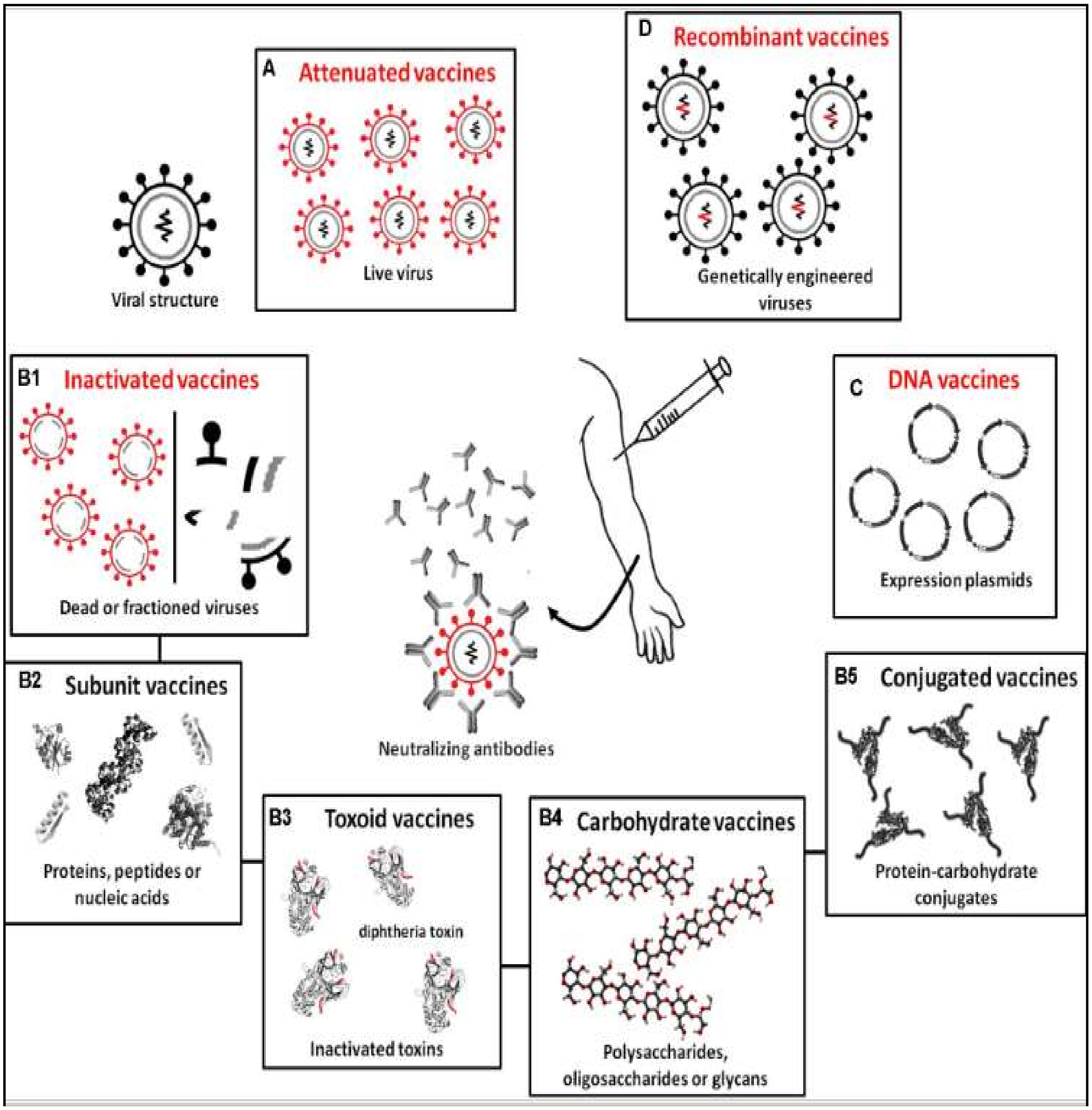

Examples of several biotechnological methods used to produce currently available vaccines can be seen in Figure 2. (A) Vaccines containing attenuated microorganisms, sometimes known as "live" vaccines. (B) The antigenic components of these pathogens have been removed, leaving just the inactivated or fractionated pathogens, vaccinations can be categorised into (B1) whole or fractioned; (B2) subunit vaccines which use proteins, peptides, or nucleic acids as antigens; (B3) toxoids which use inactivated pathogen toxins as antigens; (B4) carbohydrate vaccines; and (B5) conjugate vaccines, which mix polysaccharides and transport proteins. (C) DNA vaccines containing plasmids containing genes expressing immunogenic antigens. (D) Virus recombinant vaccines comprising genes expressing antigens from different disease-causing viruses.

It is possible that probiotics, which are live microorganisms, can improve the health of the host. "Organisms and substances that have a favourable effect on the host animal by contributing to its gut microbial balance." Probiotics can be found in fermented foods, such as yoghurt, soy yogurt, and dietary supplements, as well as in fermented meals. Stool from a healthy donor is also used in faecal transplants, where it is inserted into an infected patient like an intravenous line. [20]

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Bacillus coagulans GBI-30, 6086	May improve abdominal pain and bloating in IBS patients. May increase immune response to a viral challenge.
Bifidobacterium animalis subsp. *lactis* BB-12	May have an effect on the gastrointestinal system.
Bifidobacterium longum subsp. *infantis* 35624	Possible relief from abdominal pain/discomfort, bloating and constipation.
Lactobacillus acidophilus NCFM	Shown in one study to reduce the side effects of antibiotic therapy.
Lactobacillus paracasei St11 (or NCC2461) *Lactobacillus johnsonii* La1 (= Lactobacillus LC1, *Lactobacillus johnsonii* NCC533)	May reduce incidence of *H. pylori*-caused gastritis and may reduce inflammation.
Lactobacillus plantarum 299v	May affect symptoms of IBS.
Lactobacillus reuteri ATCC 55730 (*Lactobacillus reuteri* SD2112)	Evidence for diarrhea mitigation in children, decreased crying in infantile colic, *H. pylori* infection, antibiotic-associated side-effects, fever and diarrhea in children and number of sick days in adults.
Lactobacillus reuteri Protectis (DSM 17938, daughter strain of ATCC 55730)	Evidence for shortened duration of diarrhea in children, decreased crying in infantile colic, reduced risk of diarrhea in children, may affect constipation and functional abdominal pain in children.
Lactobacillus reuteri Prodentis (DSM 17938/ATCC 55730 and ATCC PTA 5289 in combination) for oral health	Evidence for effect on gingivitis and periodontitis,[103][104][105][106] preliminary evidence for reduction of oral malodor, evidence for reduction of risk factors for caries.
Saccharomyces boulardii	Good evidence for treatment and prevention of antibiotic-associated diarrhea and acute diarrhea.
Tested as mixture: *Lactobacillus rhamnosus* GR-1 & *Lactobacillus reuteri* RC-14	In one study, oral ingestion resulted in vaginal colonisation and reduced vaginitis.
Tested as mixture: *Lactobacillus acidophilus* NCFM & *Bifidobacterium bifidum* BB-12	Preliminary evidence for reduced *C. difficile*–associated disease.

Table 1. Source of Probiotics and Effect on Body

Bacteria also play a significant part in the production of several hormones, making them useful in the struggle against serious diseases. The genetic engineering is the most important principle used in the synthesis of hormones. Bacterial cells undergo transformation before being employed to make commercially valuable goods. A few examples are the creation of human insulin for the management of diabetes and the treatment of pituitary dwarfism with human growth hormone, also known as somatotrophin [21]

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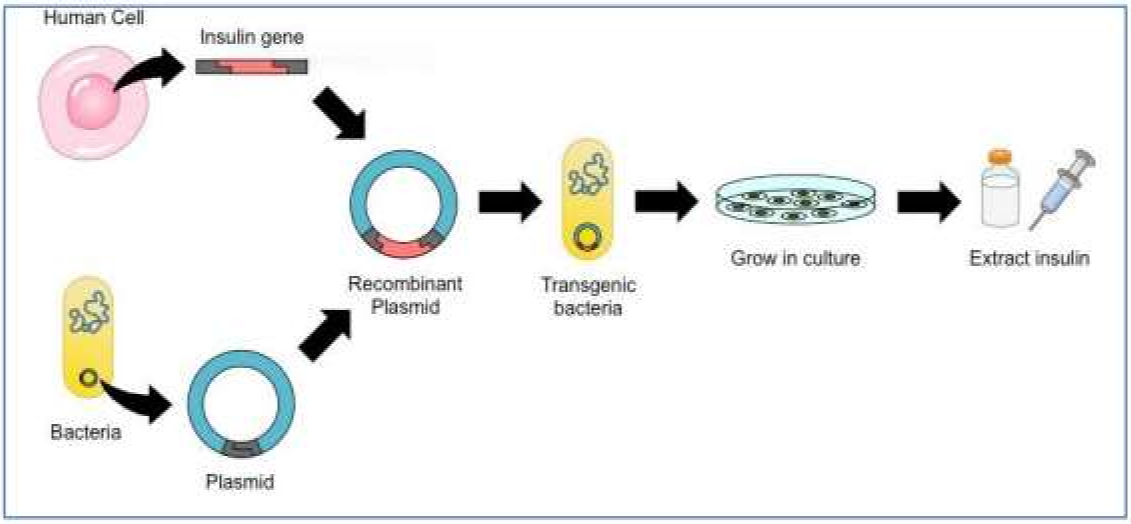

Fig. 3 Shows production of human insulin from bacterial cell via genetic engineering approach

Conclusion

Natural organisms, laboratory-selected mutants, and even genetically modified organisms are all used in industrial microbiology (GMOs). A growing number of people are on both sides of the argument over the use of genetically modified organisms (GMOs) in the food supply. Food safety, production, processing, preservation, and storage all rely on microbiology. Bacteria, mold, and yeasts are used in the manufacture of food and food ingredients (wine, beer, bakery products, dairy, etc.). A food can become contaminated with microorganisms throughout the production process, from growing to harvesting to transportation and storage to the final preparation stage.

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