Preface

An enormously diverse group of microbes contribute to our health, food, agriculture, and environment. Over the last century, microorganisms have been exploited for the production of numerous enzymes, food ingredients, pharmaceuticals, solvents and chemical feedstocks etc.

Since very ancient times man have been utilizing microbial population for the production of priceless products via various fermentation processes which includes traditional fermented foods and beverages such as bread, beer, wine, vinegar, yoghurt and cheese, as well as fermented fish, meat and vegetables. Currently, more than 3500 traditionally fermented foods exist in the world. Fermentation is both transformation and preservation techniques for food and also improves its nutritional and organoleptic qualities. Additionally, a well conducted fermentation process favours useful microbial flora, to the detriment of undesirable flora in order to prevent spoilage and promote taste and texture.

Enzymes are being known to mankind since the ancient human civilization. Microbial enzymes are currently acquiring much attention as they are preferred due to their economic feasibility, high yields, consistency, ease of product modification and optimization, regular supply, rapid growth of microbes on inexpensive media, stability, and greater catalytic activity. Current applications are focused on many different markets including pulp and paper, leather, detergents and textiles, pharmaceuticals, chemical, food and beverages, biofuels, animal feed and personal care, among others. Also, they play a major role in the diagnosis, treatment, biochemical investigation, and monitoring of various dreaded diseases.

Bioenergy is major stake holder in meeting global future energy needs and is the only renewable source that can replace fossil fuels in all energy markets. The recent period has seen a renewed intense focus on biomass to bioenergy conversion technologies and processes, with the aim of developing economical and sustainable solutions at commercial scale. First generation bioenergy used starch-based agricultural products as substrates and second-generation bioenergy uses the lignocellulose present in biomass, agricultural residues and wastes. Hydrolytic enzymes generally derived from microbial sources is the preferred option as they selectively convert carbohydrate-rich biopolymers in biomass to fermentable sugars, without formation of by-products that inhibit downstream bioenergy and biorefinery conversion processes. Utilization of each fraction in biomass provides an effective way to minimize environmental pollution, address food security problems and improve agricultural waste management approaches.

Currently, the bacterial resistance, especially to most commonly used antibiotics has proved to be a severe therapeutic problem. Therefore, we are forced to develop an alternative or supportive treatment for successful cure of life-threatening infections. Endolysins are enzymes used by bacteriophages at the end of their replication cycle to degrade the peptidoglycan of the bacterial host from within, resulting in cell lysis

and release of progeny virions. Endolysins when applied externally can make them interesting antimicrobial candidates, particularly in light of increasing bacterial drug resistance. The development of molecular biology and novel generation methods of sequencing has opened up new possibilities in the design of engineered phages and recombinant phage-derived proteins in combating multidrug resistant infections.

The new found awareness in human safety and environmental conservation has kindled fresh enthusiasm for natural sources of colors. Among microbes, bacteria have immense potential to produce pigments. Bacterial pigments due to their better biodegradability and higher compatibility with the environment, offer promising avenues for various applications in food, pharmaceuticals, cosmetics and textiles. Production of pigments by fermentation has a number of advantages: cheaper production, easier extraction, higher yields, and abundant raw materials. Optimization of fermentation process and the medium components are reported as key strategies for economic recovery of pigments.

Antimicrobial peptides encompass a wide variety of structural motifs which confer their antimicrobial activity. Peptaibols and peptaibiotics show interesting physico-chemical and biological properties including the formation of pores in bilayer lipid membranes, as well as antibacterial, antifungal, occasionally antiviral activities, and may elicit plant resistance. They have unusual amino acid content which are the result of non-ribosomal biosynthesis.

Throughout history the metabolic activities of fungi have been harnessed for various industrial applications. Fungi are indispensable biotechnological tools central to the commercial manufacture of fermented food, pharmaceuticals, organic acids, enzymes. Currently, fungal derived enzymes that degrade plant derived biomass are being utilized for the development of bioprocesses for biofuel and renewable chemical production. The metabolic and enzymatic diversity of fungi will continue to be developed for several industrial products.

Cyanobacteria have been identified as a rich source of biologically active compounds with antiviral, antibacterial, antifungal and anticancer activities and secondary metabolites including exopolysaccharides, vitamins, toxins, enzymes pharmaceuticals and polyhydroxyalkanoates. Cyanobacterial hydrogen has been considered as a very promising source of alternative energy. Additionally, they are also used in wastewater treatment, food, fertilizers and aquaculture.

Recent advances in genomics, metagenomics, proteomics, efficient expression systems, metabolic engineering and emerging recombinant DNA techniques have facilitated the discovery of new microbial applications. Metagenomic libraries should be constructed to discover new functional genes in microorganisms that are involved in the biosynthesis of biotechnological relevant compounds.

Most recent research, current technologies and advancements on applications of microorganisms in various areas are extensively covered in the book. The merits and drawbacks of each microbial application is described in the book. All the chapters in the book are derived from international scientific experts in their respective research

areas. Chapters are also designed to facilitate early stage researchers, and enables them to easily grasp the concepts, methodologies and applications of microbial technologies.

Professor Pramod W. Ramteke
Jacob School of Biotechnology and Bioengineering,
Sam Higginbottom Institute of Agriculture, Technology and Sciences,
Allahabad- 211007
INDIA