Dept: Department of Physical Sciences
Year: Year 3 Semester 2
Course Code: ICH 3104
Course Title: Biotechnology Chemical Processes
Program: Bachelor of Science in Industrial Chemistry

ICH 3104: Biotechnology Chemical Processes

Introduction

This course introduces students to the basic concepts and principles of biotechnology, gives a brief study of microbiology, and application of microorganisms in technology for processes such as, fermentation of wine and vinegar, use of yeast cells in baking (bread), beer, yogurt etc. Students will receive training in the preparation and presentation of industrial catalysts, and in the industrial applications of microorganisms and biocatalysts. Specialist lectures (some of which may be provided by outside lecturers) will be given in biotransformation processes. Under kinetics of biological systems, the course focuses on the kinetics of enzymes catalyzed reactions, derivation and application of the michaelis-Menten equation to study biochemical reactions. A brief but balanced discussion of methods for cultivation of microorganisms is covered. Specialty Bioproducts for Agricultural, Food and Pharmaceutical Industries are discussed as well.

Learning Objectives

The course is intended

(i) To introduce to students the basic concepts and principles of Biotechnology
(ii) Enable students to understand the five eras of development of Biotechnology
(iii) The course is designed to impart the knowledge of industrial bioprocesses, industrial production of primary metabolites, secondary metabolite using living cells.
(iv) Train students to apply principles of biotechnology in brewing and fermentation, genetic engineering, production of antibodies from microbes, manufacture of vaccines, sewage treatment etc.

Overview

Biotechnology is the use of living systems and organisms to develop or make products, or "any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use". Depending on the tools and applications, it often overlaps with the (related) fields of bioengineering, food biotechnology, biomedical engineering, bio-manufacturing, molecular engineering, microbiology, biochemistry, etc.

For thousands of years, humankind has used biotechnology in agriculture, food production, and medicine. The term is largely believed to have been coined in 1919 by Hungarian engineer Károly Ereky. In the late 20th and early 21st century, biotechnology has expanded to include new and diverse sciences such as genomics, recombinant gene techniques, applied immunology, and development of pharmaceutical therapies and diagnostic tests.

Definitions and Concepts

The wide concept of "biotech" or "biotechnology" encompasses a wide range of procedures for modifying living organisms according to human purposes, going back to domestication of animals, cultivation of the plants, and "improvements" to these through breeding programs that employ artificial selection and hybridization. Modern usage also includes genetic engineering as well as cell and tissue culture technologies. The American Chemical Society defines biotechnology as the application of biological organisms, systems, or processes by various industries to learning about the science of life and the improvement of the value of materials and organisms such as pharmaceuticals, crops, and livestock. As per European

Federation of Biotechnology, Biotechnology is the integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services. Biotechnology also writes on the pure biological sciences (animal cell culture, biochemistry, cell biology, embryology, genetics, microbiology, and molecular biology). In many instances, it is also dependent on knowledge and methods from outside the sphere of biology including:

- bioinformatics, a new brand of computer science
- bioprocess engineering
- bio-robotics
- chemical engineering

Conversely, modern biological sciences (including even concepts such as molecular ecology) are intimately entwined and heavily dependent on the methods developed through biotechnology and what is commonly thought of as the life sciences industry. Biotechnology is the research and development in the laboratoryusing bioinformatics for exploration, extraction, exploitation and production from any living organisms and any source of biomass by means of biochemical engineering where high value-added products could be planned (reproduced by biosynthesis, for example), forecasted, formulated, developed, manufactured and marketed for the purpose of sustainable operations (for the return from bottomless initial investment on R & D) and gaining durable patents rights (for exclusives rights for sales, and prior to this to receive national and international approval from the results on animal experiment and human experiment, especially on the pharmaceutical branch of biotechnology to prevent any undetected side-effects or safety concerns by using the products).

By contrast, bioengineering is generally thought of as a related field that more heavily emphasizes higher systems approaches (not necessarily the altering or using of biological materials *directly*) for interfacing with and utilizing living things. Bioengineering is the application of the principles of engineering and natural sciences to tissues, cells and molecules. This can be considered as the use of knowledge from working with and manipulating biology to achieve a result that can improve functions in plants and animals. Relatedly, biomedical engineering is an overlapping field that often draws upon and applies *biotechnology* (by various definitions), especially in certain sub-fields of biomedical and/or chemical engineering such as tissue engineering, biopharmaceutical engineering, and genetic engineering.