Role of fermenter and bioreactor in drug development

by Genesis Technology

The history of human civilization is too long and non-stop having its own evolution and dynamics. At any given time a civilization requires few basic things i.e., food, clothe and shelter. In modern society medicines have been added up. The history of drug development is also too long. It starts from Ayurveda and continues to modern drugs and enters into solution of incurable diseases like cancer, AIDS and HIV.

Now the question arises, what are the limits of the earth for support of man? How can we establish a pattern of use of the earth that keeps many possibilities open for the future, a pattern of development that is sustainable?

The underling problem is growth in the human population, a growth sustained by new technology that allows more intensive of resources and expansion into untouched realms of the earth. At each stage of technological development, there is an optimum size of population that offers highest standard of living. Below that population size, the potential of the available technology is not realized; but as economic, social and political forces push populations above the optimum, resources are degraded progressives. The pattern is fundamental, a framework within which the effects of the biotic impoverishment of the earth now under way can be reviewed.

The world's most important resources are biotic - the plants and animals that maintain the biosphere as a habitat suitable for life. The continued expansion of the human enterprise in its current mode is reducing both the number of species and flux of the energy through biotic systems.

The solution, if there is one, must recognize that natural communities whose functions are poorly known dominate detailed management of the biosphere. The most practical steps seem to be those that limit human intrusion.

1. Steps towards closing man dominated systems such as agricultural and industrial activities to the point where their net effects on the biosphere approximate those of the natural systems they have replaced

2. Zoning segments of the biosphere to maintain diversity at all levels.

There are the large steps. They will require substantial innovation, scholarship, technology and engineering. The earth is obviously finite; its resources limited. But the questions of how; large it is and what the limits might be for the support of man are not as easily answered as the concept of a finite earth might imply. The question of how many people the world can support is unanswerable in a finite sense. What do we want? What purposes do the poverty and political chaos in nations attempting to serve? Support the world's densest populations: India, China, EI Salvador and soon much as Africa.

An approach Towards the Solution of Problem

The Science has the answer. Biotechnology, (a combination of biology, physics, chemistry, statistics and mathematics) a new subject has been developed gradually to explore the possibilities of solving global major issues like hunger, shelter, incurable diseases. As a result, Biotechnology has broaden its wings into many fields like agriculture, microbiology, biomedical, chemical; molecular biology, genetic engineering, forensic, petrochemical, environment, pharmaceuticals, tissue culture, pharmacology, space research and toxicology.

Microorganisms based drug research, an area where we need to culture specific organisms like bacteria with some stringent monitoring and control options to serve specific goal.

However, industrial microbiology deals with all forms of microbiology, which have an economic aspect. It deals with those areas of microbiology on which, in some manner, a monetary value can be placed, regardless of whether the microbiology involves a fermentation product or some form of deterioration, diseases or waste disposal. In most instances, the economic criterion applies to a desire either to cause or to allow some specific type of growth or metabolic activity or to prevent microbial growth.

These considerations make it apparent that industrial microbiology is a very broad area for study. In fact, many non-industrial areas of microbiology are important to industrial microbiology and should be taken into consideration in understanding the concepts and practice of industrial microbiology. These areas include, among others, soil and agriculture microbiology, medical microbiology, microbial physiology, cytology and physiology, morphology, virology, genetics, marine microbiology, food and dairy microbiology and immunology.

The system

The industrial usage of microorganisms often requires that they can be grown in large vessel containing considerable quantities of nutritive media. The vessels are commonly called fermenters and they can be quite complicated in design, since frequently they must provide for the control and observation of many parameters e.g. microbial growth and biosynthesis.

The fermenter is designed to provide the best possible growth and biosynthetic conditions for industrially important microbial cultures and to allow ease of manipulation for all operations associated with the use of fermenters. The vessel must be strong enough to withstand the pressure of large volumes of aqueous media but at the same time, the materials from which they are fabricated must not be corroded by fermentation product nor contribute toxic ions to the growth medium.

However, a standard fermenter/ bioreactor can be any size depending on application. It may be of glass vessel or stainless steel or nay other special material. The system have the facility to control all possible options like temperature, Dissolve oxygen, foam, agitation, in situ sterilization or auto calve, pH, an line biochemistry analyzer. Sampling can done through syringe / pipettes or peristaltic pumps.

The SCADA software allows total monitoring and control of the reaction. An intuitive interface, 2D and 3-D import facility, statistical process control are few technical features. Network support and advanced script programming make the software flexible and suitable for any operational needs.

Area of Research and Few Recent Developments

Cancer research: Bioreactor has cultured single cell of cancers of the skin (melanoma), rostate, ovary, breast, bone and colon into viable cell cultures. Tissue cultures can be grown for at least 60 days before they become too large to remain suspended in the bioreactor growth medium.

Infectious Diseases: The US army medical research institute of infectious diseases uses the bioreactor to grow cultures rather than using live animal in the study of how the Ebola Virus transmitted.

Immune System Repression: One of the marvels of the human immune system is how lymphocytes, like escape artists, squeeze through the tight spaces between cells in search of invading diseases. Bioreactor studies using collagen reveal that lymphocytes exposed to simulate low-g for 72 hours do not move. This has been verified with experiments aboard shuttle missions and demonstrates that the bioreactor is a good simulation of low growth conditions.

Drug efficiency: Kidney and heart tissues cultured in the bioreactor show the appropriate drug receptor sites that allow testing drugs to determine their safety without using animals. This also reduces the need to use human volunteers in final testing.

National Institute of Health: In 1994, NASA and national institutes of Health signed an interagency agreement to provide NASA bioreactor technology to NIH and to establish a joint center for three-dimensional tissue culture at national institute pf child health and Hunan development.

Antibiotic Production: The industrial industry received its greatest impetus for expansion and profits with the advent and exploitation of antibiotics chemotherapeutic agents. The demand of penicillin during World War II and later for streptomycin and other antibiotics brought on the undertaking of intensive research programs deigned to find organisms capable to produce good antibiotics.

AIDS Research

- Drug efficiency testing
- Evaluation testing
- Drug combination studies

Tuberculosis Research

- In vitro and in vivo testing
- Multiple drug resistant strains

Molecular Biology and Genetic Engineering

- Biosensors
- Gene expression studies
- PCR technologies

Bio pesticide safety assessment

--Microbial and biochemical pesticides

Conclusion

Human health and well-being are affected by many factors and although underlying genetic and physiological processes may be among the first to spring to mind in terms of specific medical disorders, it is increasingly clear that life style and exposure to environmental factors also play an important role. Statistics suggest that more that 4 million people are infected with Salmonella and, E.coli are related bacteria each year in the UK. Growing old and suffering associated health changes may not be perceived as a medical issue at all.

Knowledge about basic biological processes id directly relevant to health issues such as food safety and maintenance of health span. And it perhaps goes almost without saying, that basis research into biological systems such as body's defensive immune system, provides knowledge that is directly relevant to our understanding of diseases processes and which may be used, therefore, to design new strategies for medical intervention. But it is probably in the area of developing new drugs and new approaches to the prevention and treatment of currently intractable conditions that the rapid advances in the biological sciences will make their greatest impact in the short term. However, Bioreactor and fermenter is very important tool to explore the different stains of microorganisms, which are of our interest.