Chapter 55
Industrial Enzyme Technology: Potential Applications

Michael Bamitale Osho
McPherson University, Nigeria

ABSTRACT

Biotechnology, being the application of biological organisms and their components in pharmaceutical and other industrial processes, has emerged as the basic transformation tool for starch hydrolysis enzyme. Several advantages over chemical catalysts under mild environmental conditions with efficiency and high specificity have been accrued to this fact. Such include ingredient substitution through continuous fermentation, increased products yield and plant capacity, processing aid substitution, more efficient processing, less undesirable products with improved products. This chapter reports on the molecular properties of thermostable enzymes such as alpha-amylases, alpha-glucosidases, glucoamylases pullulanases as relates to pharmaceutical industries; highlights various technology development, continuous solid-state fermentation, metabolic engineering, sol-gel immobilized enzyme arrays often use in enzyme industries. The new modern biotechnology leads to improvement in the effects of various physiological conditions which may allow various industrial processes to carry out lower energy consumption, harmless to the environment, high efficiency, and the product's properties enhancement.

INTRODUCTION

History of enzyme technology dated back to 1874 began when Christian Hansen, a Danish Chemist extracted dried calves' stomachs with saline solution to produce rennet which was the first enzyme used for industrial purposes. French scientist, Louis Pasteur in 18th century discovered the fermentative activity of microorganisms. There were several experiments conducted by Eduard Buchner in 1897 at the University of Berlin, to study the ability of yeast extracts to ferment sugar and he found out that the sugar was fermented even when there were no living yeast cells in the mixture and the enzyme was named "zymase". Enzymes were used in 1930 in fruit juice clarification/manufacturing. Early 1960s starch industries witnessed a great advancement with the usage of alpha-amylases and glucoamylases which completely replaced traditional acid hydrolysis of starch.

DOI: 10.4018/978-1-5225-8903-7.ch055

Enzyme technology is a section of the biochemical science that is going through a stage of ontogenesis and significance recognitions in global industrialization. Biotechnology can be defined as the application of biological agents using scientific and engineering principles to the processing of materials to provide goods and services for human. It has a large impact and offers the potential for new industrial processes that are based on renewable raw materials and require less energy (Hamlyn, 1997). In industrial and analytical fields, biotechnology is currently considered as a useful alternative to process technology. Several advantages over chemical catalysts under mild environmental conditions with efficiency and high specificity have been accrued to this fact. Such include ingredient substitution through continuous fermentation, increased products yields and plant capacity, processing aid substitution, more efficient processing, less undesirable products with improved products (Souze, 1980). Biotechnology utilizes a wide range of enzymes produced on a commercial scale employing supposedly screened microorganisms. Such microorganisms have been characterized and optimized to synthesis a high-quality enzyme on large scales for industrial applications. Molecular biology techniques have allowed us to tailor a particular microorganism to produce enzyme with desired characteristics such as tolerance at high temperature and its stability in acidic or alkaline environment, thermostability, and high yields of an enzyme, but also retaining the enzyme activity under critical reaction conditions such as in presence of other metallic ions or compounds. However, the use of enzymes in industrial applications has been limited by several factors, mainly their instability, high cost of the enzymes, solubility in aqueous substrate and difficulty in recovery from bioreactor effluents. There have been several intense researches in the field of enzyme technology that has facilitated their practical applications (Mahmoud & Helmy, 2009). The main objective of this chapter is to extensively explore the great values of starch hydrolyzing enzymes as prospective tool for the many biotechnological opportunities they offer in pharmaceutical industry.

BACKGROUND

Biotechnology has influenced almost every sector of industrial activity- food, chemical feedstock, energy, feed, environment, and health care, these are directly driven by economic, environmental and social needs. It requires an understanding and application of a range of basic scientific and engineering disciplines, including microbiology, biochemistry, physics, chemistry, chemical and bioprocess engineering, besides molecular biology and genetics. Other features include their dependence on renewable feedstock, low energy consumption and environmentally favorable processing that can potentially lead to sustainable development. Although biological processes involving living cells and their constituents have been used by mankind, real break though has emerged with developments in both biological and engineering sciences, during the last fifty years. Table 1 revealed the impacts of emerging technologies on enzyme technology. All chemical reactions occurring in living cells (for breakdown of nutrients and synthesis of cellular constituents) are catalyzed by their group of molecules - enzymes. These are naturally evolved biocatalysts that are designed to perform their function in an efficient manner, and still providing a precise and suitable control mechanism to the cell for survival under range of environmental conditions with numerous applications in every sector. There exist more than 3,000 different known enzymes of which only 150 to 170 are used commercially. Currently only 5% of chemical products are produced using biotechnological methods. Enzymatic processes are fast becoming better financial and ecological alternatives to chemical-physical and mechanical processes and applications by virtue of being cost effective and more environmental friendly. Enzymatic processing of various application areas