ISSN 0975-6299 Vol.1/Issue-3/Jul-Sep.2010

International Journal of Pharma and Bio Sciences

INDUSTRIAL BIOTECHNOLOGY-A SUSTAINABLE FUTURE

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INTRODUCTION

Biotechnology is defined as any technique that uses living organisms or part of organisms to make or modify products, to improve plants and animals or to develop microorganisms for specific uses. It is easy to see that biotechnology is an old and well-established science, affecting every day of our lives (**U.S government**).

INDUSTRIAL BIOTECHNOLOGY

Industrial biotechnology (also known as white biotechnology - white being a symbol for clean and sustainable technology), a third wave of biotechnology, is the strong emerging field with broad application for the sustainable renewable resources using living cells and or their enzymes .Living cells may be used as they are or improved to produce new products for industry.
This usually results in more profit-based products with lower production costs, less pollution and resource conservation.

HISTORY

Biotechnology is not new – its underlying processes have been used by mankind for thousands of years. It begins when primitive man became domesticated enough to breed plants and animals, gather and process herbs for medicine, make bread and wine and beer, create many fermented food products including yoghurt, cheese and various soy products, create septic systems to deal with their digestive and excretory waste products and to create vaccines to immunize themselves against diseases.

Modern biotechnology refers to the application of biological organisms, systems and processes to the provision of goods and services (Teusink B, Smid EJ, 2006; Nga, 2005). It uses enhanced microorganisms, like yeast, moulds and bacteria as **"cell- factories"** along with the enzymes derived from them to produce variety of goods (Klaenhammer *et.al.,* 2005).

Modern biotechnology reveals in roads into nearly all the major fields of human endeavor. It found its entry into medicine (**red biotechnology** - directed towards health care), agriculture (**green biotechnology** - directed towards health crops) and now a new wave of modern biotechnology is gaining momentum- "**white biotechnology** "is the application of natures toolset to industrial production.

Industrial uses of biotechnology

Renewable raw materials **:** Use of renewable resources is very closely bound to the fossil raw materials that might replace and suffers when oil is relatively cheap. There has been increased interest in production of chemicals using renewable feedstocks, agricultural feedstocks

such as corn, which can be used to produce low cost starch raw materials.

Living plants are used to manufacture chemicals such as lactic acid, lysine and citric acid on a commercial basis. A team at Monsanto used rape seed plant (***Brassica rapa***) and cress plant (***Lepidium sativum***) to synthesis a biodegradable plastic known as **polyhydroxyalkanoate (PHA)** by adding bacterial genes from ***Ralstonia eutropha***, because it produces high levels of PHA.

Sugar and starch sector produces carbohydrate such as sugar, glucose, starch and molasses from plant raw materials like sugar beet, sugar cane, wheat, corn etc. Oil and fat processing sector produces numerous oleo-chemical intermediates such as fatty acids, glycerol, triglycerides and fatty alcohols from plant raw materials like rapeseeds, palm oil, coconuts and animal fats. Wood processing sector, particularly the cellulose and paper industry produces mainly cellulose, paper and lignins from wood.

BIOPROCESSES

ENZYMATIC PROCESSES

Enzymes are nature's accelerators for digesting materials and catalyzing reactions. They are already being applied today in chemicals, pulp and paper, food processing, mining textiles and consumer goods. Also, they are used as free or immobilized whole cells, crude and purified enzyme preparations, bonded to membrane or in cross linked crystals.

FERMENTATION PROCESSES

Industrial biotechnology is used to produce a wide variety of bulk and fine chemicals like alcohol, lactic acid, citric acid, vitamins, amino acids, solvents, antibiotics, biopolymers etc. Industrial fermentation is the main technology, whereby microorganisms are cultivated that efficiently convert sugars into useful products (Foster, 1939; Perlman, Dorrell, and Johnson,1946; Porges, 1932).

VITAMINS

Traditionally, vitamin B_2 is produced using a complex eight step chemical process. But biotechnology reduces the production to a one-step process. This single step is a fermentation, where by the raw material is fed to a microorganism, that transform it into finished product. Vitamin B_2 is recovered as yellow crystals directly from fermentation.

ANTIBIOTICS

Antibiotic production is practiced on an industrial scale for several years. The traditional chemical process involved many steps. But, now a mild biotransformation route was established to reduce the process steps substantially (Shu,1998). New route is based on a fermented intermediate linked enzymatically with a side chain to the final end product. This process uses less energy and less input chemicals and generates less waste.

BIO-BASED POLYMERS

Polymers are traditionally produced from limited fossil resources such as oil and natural gas. Bio-based polymers use renewable resources like sugars or corn as raw material. Bio-based polymers are used to produce clothing, packaging materials and electronic goods. New products incorporate the use of dextrose as one of its key feedstock's. Today, these polymers are competitive and high potential (Steinbüchel 2001).

BIOETHANOL

Industrial biotechnology also enables the production of bioethanol (biofuel) (Berg 1999). Cornstarch and sugarcane are presently the major sources of ethanol, which is blended with petrol or used on its own. The **US** currently has 58 fuel ethanol plants producing 5.67 billion liters per year. A major vehicle manufacturers warrant their cars for use of **E-10 fuel** (10% ethanol +

90% petrol). Many manufacturers are now capable of accepting blends up to 85% ethanol.

Main focus is on the production of human proteins (Steinbüchel,A, 2001) (therapeutic, vaccine and diagnostic proteins) and industrial proteins. Also proteases added to bread (bread conditioners) to decrease the rising time of bread; glucose isomerase's which is used in fructose formation from glucose syrup, proteases and lipases incorporated into detergent products to take out stains and proteases used in the leather industry to remove hair and soften leather.

"*Industrial Biotechnology can be a key component of future strategies for viable economic growth. The road to a broad application of biotechnology in industry is not always smooth, as there are many issues that hinder its full- scale roll out. It can provide a cheaper option to achieve industrial sustainability than traditional process and economic and environmental improvement need not to be strange bed-fellows.*"

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