Chapter 31
Microbe Mediated Bioconversion of Fruit Waste Into Value Added Products:
Microbes in Fruit Waste Management

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ABSTRACT

Biosynthetic capabilities of microbes have solved several hurdles in the human welfare. Microbes have served and continue to serve as imperial candidates in both production and management strategies. Microbe mediated techniques has emerged as ecofriendly and sustainable alternative to their synthetic counterparts. Fruit based industries produces large volumes of solid and liquid wastes contributing to increase in pollution load. Disposal of these waste not only represent loss of valuable biomass but also leads to substantial increase in Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). However, in spite of their pollution and hazard aspects, in many cases, fruit processing wastes have a promising potential for being chief raw materials for secondary industries. This chapter summarizes microbe mediated fermentative utilization of fruit waste, for the production of value added products like organic acid, single cell protein, bioplastics, enzymes and biogas.

INTRODUCTION

The exponential growth of the human population has led to the accumulation of huge amounts of biodegradable and non-biodegradable waste materials across the world (Rivard et al., 1995). Living conditions in the biosphere are therefore changing dramatically, in such a way that the presence of waste residues is affecting the potential survival of many species. Fruit peels are a class of agro wastes that may be

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regarded as a non-product flow of raw materials having economic values less than the cost of collection and recovery for reuse. Fruit based industries produces large volumes of wastes, both solid and liquid; these wastes pose increased disposal and pollution (High BOD or COD) problems and represents a loss of valuable biomass and nutrients. In spite of their hazardous effects contributing to environmental pollution, fruit peels have a good potential for conversion into useful products of higher value as by-product, or even as raw materials for other industries. Fruit waste contain an appreciable amount of carbohydrates which could be utilized by microorganisms producing economically important Biopolymers, Single Cell Proteins, Organic acids, Enzymes, Biogas etc. with potential application in food, fuel, agriculture, packaging, and pharmaceutical industries.

Bioplastics especially polyhydroxyalkanoates (PHA's) are exclusively synthesized as intracellular carbon and energy storage compounds by wide range of microorganisms and are reported to be completely degraded in to benign compounds both aerobically and anaerobically (Lemoigne, 1926). Their material properties closely resemble synesthetic plastics and thus are emerging to be the best alternatives to their synthetic counterparts. The ability to be synthesized from a wide variety of waste substrates along with their fully degradable nature is an added advantage to this kind of biopolymers.

SCPs are protein rich microbial biomass or total proteins extracted from microbial cell that could be used as protein supplements in food and feed (Gour et al., 2015). Their nutritious value and growth promoting essential amino acids content makes them ideal for tackling the global issues associated with Protein Calorific Malnutrition (PCM). Production of organic acids from fruits and fruit wastes dates back to several centuries. It is still an important industry that sustains the economy of many developed, developing and under developed countries. Acetic acid, butyric acid, lactic acid, citric acid and tartaric acid are the well-known examples of microbe mediated 'organic acids'. Enzyme production from fruit wastes using microbes could pave as a sustainable method for reducing cost of production. Fruit peels are used for the commercial production of enzymes like amylase, protease, and laccase. Microbes could also be exploited as tools for production of bioethanol and biogas from fruit peels. This serves as a promising alternative for increasing energy crisis all over the world.

Fruit peel wastes could be thus considered as valuable by-product if appropriate technical means are used to increase the value of the subsequent products to exceed the cost of reprocessing. This chapter highlights easily adoptable microbiological methodologies for recycling, reprocessing and eventual utilization of fruit peel wastes for the production of value added products rather than their discharge to the environment.

Background of the Study

Fruit wastes represent an important class of food processing waste that has been turned to be a menace for all the countries due to problems associated with their disposal and treatment. Majorly it consists of large fractions of solid or semi-solid waste generated during the separation of desired products from undesired ones in early stages of processing. Undesirable constituents discharged from fruit-based industries include fruit peels, seeds, extracted pulp and pits. Usages of these wastes either as feed ingredient for livestock or application on land are two conventional methods of fruit waste management. Major characteristic of fruit processing industries are wide range of waste water and organic load. Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) accounts for the chief pollutants in the fruit-based waste. Fruit based industries are conservative and reluctant to invest capital in waste management principles. The fruit processing industry produces 12 million tons of fruit annually. This in turn generates