Chapter 2
Mycotechnology for Lignocellulosic Bioethanol Production: An Emerging Approach to Sustainable Environment

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ABSTRACT
One of the major challenges for society in 21st century is to find a sustainable eco-friendly renewable liquid fuel for replacing petroleum based fossil fuels. Bioethanol is one of the most consumable biofuel in the world. Lignocellulosic plant biomass can be an untapped source of fermentable sugars for significant production of bioethanol. But, the polyphenolic lignin of the biomass hinders the digestibility of cellulose, thus the goal of any pre-treatment technology is to remove this structural component to improve the cellulose accessibility for enzymatic saccharification. A wide range of pretreatment methods and their combinations have been reported for delignification, but recently, the environment friendly approach of microbial pre-treatment has received much attention for enzymatic delignification and saccharification of biomass. The extracellular lignin degrading enzymes and cellulase enzyme complex from fungi are now considered for biological delignification and saccharification, respectively.

INTRODUCTION
Global warming and energy crisis are of great concern to government and people around the world. The demand of energy is globally increasing in twenty first century and one of the major challenges in front of the society is the generation of polluting gases into the atmosphere due to combustion of a...
large amount of liquid fossil fuel. In addition, the rising costs of fossil fuel due to its depletion within
the earth crust and the predicted increase of 54% in the world energy consumption, considerable atten-
tion is being directed towards the development and use of eco-friendly, sustainable, and cost effective
domestic energy source that either completely or partially replace the petroleum fuel. Bio-ethanol from
renewable plant resources including sugars, starches and lignocellulosic materials could be one such
alternative that can be used as liquid transportation fuel (Wyman, 2007). The agreement implemented
by Policy Energy Act and the Energy Independence and Security Act aims to reach 36 billion gallons
of bioethanol by the year 2022.

Biofuels

A biofuel is a fuel that stores and carries the energy derived from biomass and can be used in solid,
liquid or gaseous forms. It is produced through the biological processes rather than a fuel produced by
geological processes such as coal and petroleum. Biodiesel, and bioethanol are important liquid biofu-
els. The biofuels are classified as primary and secondary biofuels. The primary biofuels are the energy
sources taken from renewable biomass and used in an unprocessed form, basically for heating, cooking
or electricity production such as dry wood and wood chips etc. The secondary biofuels are produced by
processing of the renewable biomass such as ethanol, biobutanol and biodiesel etc. that can be used in
vehicles and various industrial processes. The secondary biofuels are further divided in to first genera-
tion, second generation and third generation biofuels on the basis of substrate or the raw material used
for their production (Nigam and Singh, 2011).

FIRST GENERATION BIOFUEL

First-generation biofuels include bioethanol and biodiesel that are produced from the biomass which is
more often edible. Ethanol is generally produced upon fermentation of monosaccharide (mostly glucose)
by certain yeast strains such as Saccharomyces cerevisiae. Sugarcane and corn are the important feed-
stocks that are generally used for the production of first-generation biofuels (bioethanol). Brazil is one
of the leading countries that is using sugarcane as a very common feedstock for bioethanol production
(Brennana and Owendea, 2010). Other feedstocks that can be considered to produce first-generation
bioethanol include whey, barley, sugarbeets, and potato waste. The three main kinds of first generation
biofuels used commercially are biodiesel (bio-esters from available oil and fat), ethanol, and biogas.
These first generation biofuels are produced in large quantities using the production process that is con-
sidered as ‘completely established technology’. But the demands of edible oils are increasing trend for
our society, moreover the food and feed competition while using the food crops for bioethanol production,
so it difficult to use the agricultural food crop for biofuel production. Thus, they pose a threat to food
prices since the biomass used are food crops such as corn and sugar beet. Again, first generation biofuel
production has contributed to increase in world prices for food and animal feeds. Additionally, biomass
for first generation biofuels requires lots of fertile land to grow, and most available rainfed agricultural
land is already in use (Brennana and Owendea, 2010; Lavoie et al., 2011). They only provide a small
benefit over fossil fuels in regard to greenhouse gases since they still require high amounts of energy to
grow, collect, and process. Thus, use of first generation biofuels is a more expensive option than gasoline,
making it economically unfavourable.