

## Bioethanol Production from Biomass

Nasrullah Shah<sup>1</sup> & Touseef Rehan<sup>2</sup>

### Abstract

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Enormous amount of biomass is depositing each day in the environment. The agriculture countries can make use of such resources for various useful purposes. Bioethanol is one of the important commodities which can be produced by using biomass. Bioethanol can be considered as future fuel which has the potential to replace fossil fuels. The selection of raw material, pretreatment process, saccharification and proper selection of yeast and bacteria strains are considered as the key steps in bioethanol production from biomass. Bioethanol is in fact a cheap source of energy and can help in clean environment management. However in few cases consideration are needed to overcome the anomalies of using some specific biomass resources which can affect our food reserves. A brief survey of the various important aspects involved in bioethanol production is done in this review to grasp the basic concept of bioethanol production from biomass.

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**Keywords:** Brief Survey, Bioethanol, Biomass, Saccharification, Fermentation

### 1. Introduction

The need of renewable, sustainable, cost effective and environmental friendly energy source is at its peak. The independence in energy source needs measures for creating and utilizing such renewable resources. The use of trees, crops, and agricultural and forestry wastes to make fuels, chemicals, and electricity is already in progress in developed and some developing countries. Even in many developed countries executive orders have passed to use such resources for clean energy production.

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<sup>1</sup>Department of Chemistry, Abdul Wali Khan University, Mardan 23200, Pakistan. E-mail address: [nasrullah@awkum.edu.pk](mailto:nasrullah@awkum.edu.pk)

<sup>2</sup>Department of Biochemistry, Quaid-i-Azam University, Islamabad 44000, Pakistan

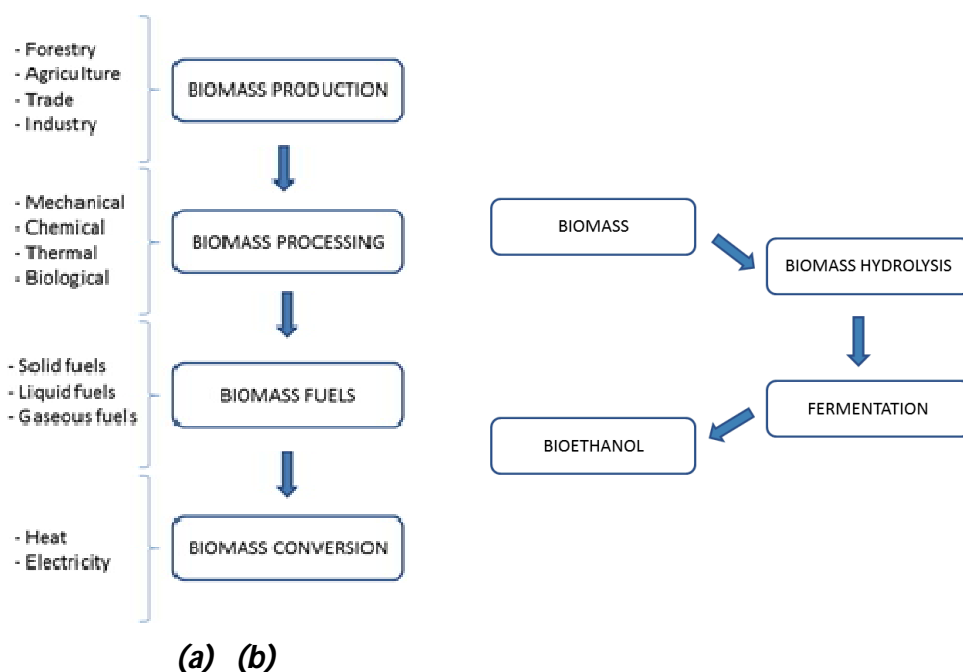
The energy production from such sources will not only add to the to overcome the energy crises but it will also result in emerging market opportunities, decreasing environmental impacts, rising energy security and diversity, reduce fossil carbon emissions, and meeting the developing need for energy and materials with sustainable technologies (Chum & Overend, 2001).

The use of fossil fuels results in many environmental problems and is also not effective and economical. Furthermore, the resources of fossil fuels are also declining. The issue of energy crises is the big challenge in the modern technological world. The improper waste management also adds to many issues regarding the environment and economy. The establishment of systems for production of renewable energy sources can greatly help in overcoming the energy crises as well as environment protection (Amin, 2009; Balan, Chiaramonti, & Kumar, 2013; Cao et al., 2014; Chandel et al., 2007; Conde-Mejía, Jiménez-Gutiérrez, & El-Halwagi, 2012; Cuzens & Miller, 1997; Haghighi Mood et al., 2013; Hamer, 2003; Hu, Heitmann, & Rojas, 2008; Marchetti, 2012; Pasha, Kuhad, & Rao, 2007; Sarkar, Ghosh, Bannerjee, & Aikat, 2012; Vertes, Qureshi, Yukawa, & Blaschek, 2010; Zhu & Pan, 2010).

Various renewable fuels are produced from waste from different sources. Bioethanol is one of the main renewable energy sources which is undoubtedly, a future fuel. Bioethanol has higher octane number and relative to that of gasoline alone, its use as a blender with gasoline reduces the emission of CO<sub>2</sub>, NO<sub>x</sub> and hydrocarbons after combustion. The use of ethanol shows high compression ratio and increased energy production in combustion engine (Balan et al., 2013; Chandel et al., 2007; Conde-Mejía et al., 2012; Haghighi Mood et al., 2013; Hu et al., 2008; Sarkar et al., 2012; Zhu & Pan, 2010).

### 1.1. Hydrolysis Process for Bioethanol Production

Acid hydrolysis of cellulosic biomass such as bagasse is an ancient technique of converting biomass into sugar and then to ethanol. Bracormet was the first who noted the Acid hydrolysis of surplus cellulosic materials, such as bagasse, into sugar in 1819 (Cuzens & Miller, 1997). In sugar industries baggas is not fully converted to energy. It is used only as feed or for fire purposes. Its complete conversion is not accomplished and is not economically utilized. The installation of hydrolysis processes can eliminate the problems to a great extent. The baggas or other biomasses are converted to sugars which are then converted to bioethanol by simple fermentation process.



**Fig. 1. (a) Biomass conversion to bioethanol (b) flow sheet of steps involved in bioethanol production from biomass upto its conversion to useful energy (Chum & Overend, 2001).**

### 1.1. Saccharification and Fermentation

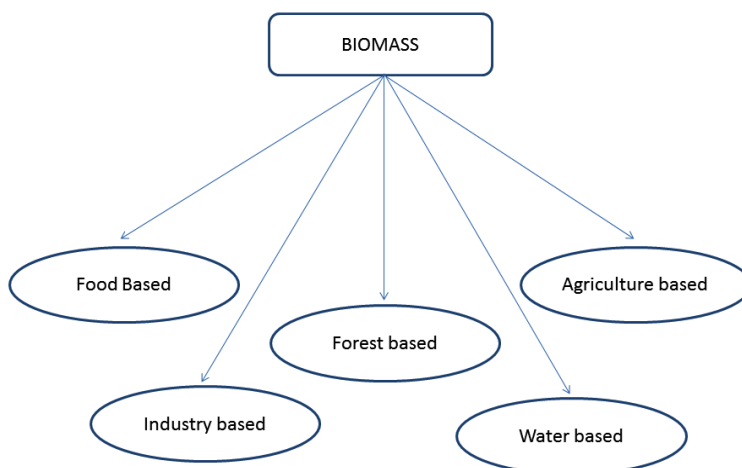
Bioethanol production from various biomass sources usually needs pretreatment and saccharification which is then converted to bioethanol by simple fermentation process. The fermentation is performed by various strains of yeast and bacteria (Cao et al., 2014; Cheng et al., 2007; Pasha et al., 2007; Walfridsson et al., 1996). The selection of strain for bioethanol production is made by considering their productivity, tolerance to ethanol, fermentation inhibitors and severe pH and temperature conditions (Cao et al., 2014). In most of the fermentation processes *S. Cerevisiae* is used. *S. Cerevisiae* is an efficient bio-ethanol producer due to its high tolerance to ethanol, low optimum pH range and anaerobic conditions requirement (Martín, Galbe, Wahlbom, Hahn-Hägerdal, & Jönsson, 2002). However, *S. Cerevisiae* is not much suitable for ethanol production from xylose as it needs modified strains or need the pretreatment of xylose by bacterial enzymes (Gong, Chen, Flickinger, Chiang, & Tsao, 1981)

## 1.2. Raw Materials for Bioethanol Production

Bio-ethanol is produced from various cheap raw materials. The bio-ethanol feed stocks are generally classified into three types i.e. starchy materials (wheat, corn and barley), sucrose containing feed stocks (sugar beet, sweet sorghum and sugar cane) and lignocellulosic biomass (wood straw and grasses etc) (Balat & Balat, 2009).

In this regard, numerous attempts to produce bio-ethanol from biomasses such as rice hulls (Dagnino, Chamorro, Romano, Felissia, & Area, 2013), sugar cane leaves (Hari Krishna, Prasanthi, Chowdary, & Ayyanna, 1998), banana (Hammond, Egg, Diggins, & Coble, 1996), baggase (Martín et al., 2002), micro-algae (Amin, 2009), sea weed extract (Horn, Aasen, & Østgaard, 2000) industrial waste (Kádár, Szengyel, & Réczey, 2004), corn stover (Kazi et al., 2010), barley straw (Han, Kang, Kim, & Choi, 2013), wood bark, forest residues and switch grass (Hu et al., 2008) agriculture residue (Demirbas, 2009) and sweet sorghum (Dalla Marta et al., 2014) etc. have been reported.

Instead of many advantages of production of bioethanol from biomass there are few limitations as well. The bioethanol production from feed stocks is not suitable as it affects the food reserves. The use of non-edible lignocellulosic biomass requires pretreatment and saccharification before conversion to bioethanol. Similarly, the use of industrial wastes containing carbohydrates is also not economical due to the presence of solid residues and other contaminations (Choi, Moon, Kang, Min, & Chung, 2009; Dagnino et al., 2013; Dalla Marta et al., 2014; Demirbas, 2009; Ewanick, Bura, & Saddler, 2007; Hammond et al., 1996; Han et al., 2013; Hari Krishna et al., 1998; Horn et al., 2000; Kádár et al., 2004; Kazi et al., 2010; Limayem & Ricke, 2012; Martín et al., 2002; Muñoz et al., 2007).



**Fig. 2: Various Sources of Biomass**

### 1.3. Conclusions

According to the increasing demand for renewable energy resources, bioethanol is considered as one of the most suitable and economical future fuels. The environmental effects caused by the biomass can be decreased by utilizing them into useful products. Various pretreatment processes and strains of bacteria and yeast are used to convert biomass into bioethanol. For renewable processing of biomass or direct bioethanol production, the cost effective technologies are needed which need further research, development, demonstrations, and diffusion of commercialized new technologies. The conversion of biomass into bioethanol not only can accomplish the demand for energy resources but all have positive effects on the environmental and socioeconomic position of the country. The further research and technologies development are needed in the field of bioethanol production so that can replace the fossil fuel causing environmental and economic burdens.

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