SOURCES OF BIOENERGY AND THEIR PRACTICALITY IN THE MODERN WORLD

Abstract

Bioenergy is one of many various alternatives accessible to assist in meeting our energy requirement. It is a renewable energy source obtained from organic molecules. Wood, agricultural products, and organic waste are examples of these materials. Currently, there is an increase in energy demand, and biodiesel production appears to be a very attractive developing sector for various reasons: it is highly biodegradable and has low toxicity, and it can replace diesel fuel in a variety of uses. As a result, there has been a surge in interest in bioenergy in recent years, this would allow for the development of a sustainable bioenergy sector. Increased production of these fuels is projected to benefit the world economy and aid in the mitigation of climate change.

Keywords: Bioenergy, Agricultural Products, Environmental Problems, Civilization, Development

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I. INTRODUCTION

The development of civilization and industrial revolution also led to drastic climate changes. This caused the temperature to rise slightly in the countries of the world, which created conditions that could lead to the extinction of plants and animals. This climate warming causes many environmental problems such as floods, cyclones, droughts, hurricanes, coastal erosion, sea level rise, and problems with the supply of drinking water for humans and animals. To mitigate the problems of climate change, research should be done on energy conservation projects and renewable energy sources. Although renewable sources of energy are more expensive to produce, conventional energy has many advantages. It reduces dependence on fossil fuels and is not as dangerous as nuclear power (Paulina Drożyner et al., 2013). These renewable energies are of many types and among them bioenergy fuel is considered to be the most important nowadays. Bioenergy is one of the important renewable resources that can help meet the energy demand for growing population and industrial progress. It is a form of renewable energy that is derived from recently living organic matter called biomass, which is used to produce transportation fuels, heat and electricity.

II. SOURCE OF BIOENERGY

According to Article 2 of the Biocomponents and Liquid Biofuels Act of August 25, 2006, biomass consists of solid or liquid substances of plant or animal origin that undergo biodegradation from agricultural and forest production products, waste, and leftovers, as well as parts of other wastes that undergo biodegradation, particularly agricultural raw material.

1. **Food Crops:** Potential crops for biofuel production include cassava, sugarcane, rice, and sweet sorghum for bioethanol, and palm oil, groundnut, and palm kernel for biodiesel. Brazil is also on the list of countries that are involved in the development of biofuels. Potential biofuel crops in Brazil include physic nut, sunflower, soybean, castor bean, African palm, cotton, peanut, linseed, sesame, canola, and others. The Federal Government of Brazil has enacted legislation authorising the use of biodiesel in national fuel markets (Lopes et al., 2013).

2. **Oil Rich Algae:** *Chlorococcum sp., Prymnesium parvum, Gelidiuma mansii, Gracilaria sp., Laminaria* sp., *Sargassum* sp. and *Spirogyra* sp. are some of the micro and macro algae used for bioenergy invention (Eshaq et al., 2011; Rajkumar et al., 2014). Land plants grow only seasonally and contain only 5% dry weight, but algae grow very fast and have high oil content, usually doubling within 24 hours, while some microalgae grow every three and a half hours. The oil content of microalgae is usually only 20-50%, but in some strains it can be as high as 80% (Metting, 1996; Spolaore et al., 2006). Light, nutrients and carbon dioxide are often essential for these algae to form large amounts of polysaccharides such as starch and cellulose. These polysaccharides can be hydrolysed to fermentable sugars, then fermented to bioethanol and purified by distillation. Algae farming offer significantly higher yields than traditional biofuel crops, which is a key advantage. Over 50% of the oil reduced to dry biomass (Adeniyi et al., 2018). Algae may be used to make a variety of fuels, including bioethanol, biodiesel, methane, kerosene for aeroplanes, biobutanol, biogas, and green diesel. Algae biodiesel has the potential to significantly improve energy security in transportation. The manufacture of jet fuel from algae has the potential to be very important in aviation. Furthermore, bio-aviation fuel

(bio-jet fuel) is recognised as a short-to-medium-term strategy for reducing GHG emissions in the sector (European Environment Agency, 2020). For this reason, the algae-to-biofuel industry is concentrating on microalgae.

3. **Stored Municipal Waste:** Municipal solid waste (MSW) is one of the resources utilized to produce bioenergy, and it includes organic garbage. One of the primary by-products of urbanisation is MSW. 1.3 billion tonnes of solid garbage are produced annually by the estimated 3 billion urban dwellers on the planet. The production of MSW could reach 4 billion tonnes by the year 2100 (Hoornweg and Bhada-Tata, 2012). If this amount of solid waste is not properly managed, it might be a significant source of methane emissions, air pollution, health hazards for people and ecosystems, and contaminated groundwater. According to van Lier et al. (2001) and Abudi et al. (2016), the organic fraction of municipal solid waste (OFMSW) is a popular feedstock for anerobic digestion (AD) and a promising source for the production of biogas. In the absence of oxygen, AD is a natural process that converts feedstock into digestate and renewable fuel (in this case, biogas). According to Bhakov et al. (2014), the biogas from AD consists primarily of CH_4 (50–70%), CO_2 (30–50%), and a few significant contaminants such NH_3, H_2S, siloxane, halides, and water vapour. It has been observed that the hydrolysis is the rate-limiting step among the four phases that occur during AD, namely hydrolysis, acidogenesis, acetogenesis, and methanogenesis, due to the relatively complex substrates used in AD (Rafique et al., 2010; Ma et al., 2011). The most prevalent method of converting trash into heat or power is direct combustion. The extracted waste fuel is combusted in the presence of surplus oxygen (the oxygen that gathers from the air) to produce energy throughout this process. At high temperatures and with regulated oxygen, waste gasification transforms organic materials into syngas containing CO, H_2, CO_2, N_2, CH_4, and other components (Patel et al., 2016). Characterising the distinct kinetics of protein, lipid, and carbohydrate biodegradation served as the foundation for this statement. As a result, it is critical to develop efficient waste to energy systems (WtE) to improve energy recovery from wastes that are now disposed of in landfills. WtE refers to the methods or processes used to produce and optimise the output of an energy source such as heat, electricity, or waste fuel (Mofijur et al., 2020). The bioenergy is motivated by the need to minimise our carbon footprint (Mofijur et al., 2016; Ong et al., 2020) and ensure the security of our fuel supply (Ong et al., 2019; Muhammad et al., 2021).

4. **Efficacy:** The energy and water content of biomass, as well as its chemical composition, determine its efficiency. Biomass feedstock can be classified as having a low heating value or a high heating value. A dry feedstock would have a high heating value for most biomass feedstock since it contains less water and can be easily burned. Lower values would be associated with aquatic and wet waste biomass. The chemical composition of a feedstock is also significant for biochemical conversion processes such as biofuel generation (ethanol, biodiesel, and so on)(Efficiency of Biomass Energy). The efficiency of biomass energy conversion into power, heat, transportation fuels, and chemicals is largely determined by the diverse thermochemical and biochemical techniques employed. By 2018, BE accounted for, respectively, 31%, 21%, 11%, 5%, and 4.5% of global energy consumption in Brazil, India, Germany, the US, and China (Kim e al., 2020). Energy crop biomass potential is anticipated to increase from 11 EJ in 2020 to 96 EJ in 2050 (Destek, et al., 2020). The 2021–2030 policies and goals are part of the 2030 climate and energy framework. The main objectives include for a minimum 40% reduction in GHG

emissions from 1990 levels, a minimum 32% contribution from renewable energy sources, and a minimum 30% increase in energy efficiency. The direct use of biofuels is said to produce much less CO_2 than the use of fossil fuels (Lin et al., 2014).

5. **Sustainability:** Regarding the long-term viability of the environment, the economy, and society, biofuels have both benefits and drawbacks (Azapagic and Stichnothe.,2011). The main global drivers of biofuels are, on the one hand, the reduction of GHG emissions, energy security, and rural development. On the other hand, there are issues with increasing the production of biofuels, including pressure on food prices, the risk of an increase in GHG emissions due to direct and indirect land-use change (LUC) from the production of biofuel feedstocks, as well as the risks of ecosystem degradation and the deterioration of land, forests, water resources, and other natural resources (UNEP, 2009). Different sustainability requirements for biofuels are outlined in regulatory regulations like the RED and RFS in order to promote the sustainable development of these fuels. The life cycle GHG emissions are one of the primary criteria. The RED mandates that for installations operating before October 2015 and beginning after that date, biofuels must have emissions that are at least 50% lower than those of their fossil fuel counterparts, and 60% lower for installations starting after that date, increasing to 65% lower for biofuel plants starting operations after January 1, 2021 (Daystar et al., 2015). While regular biofuels must achieve a 20% reduction in GHG emissions, manufacturers of advanced biofuels must reduce GHG emissions by at least 50% (EPA. 2010). To prevent transferring costs from one component of the life cycle or supply chain to another, the climate change impact related to GHG emissions and other sustainability features of biofuels should be assessed on a life cycle basis using life cycle assessment (LCA).

6. **Improvement Bioenergy:** Today, modern bioenergy is the world's greatest source of renewable energy, accounting for 55% of renewable energy and more than 6% of global energy supply. The Net Zero Emissions by 2050 (NZE) Scenario predicts a rapid growth in bioenergy use to supplant fossil fuels by 2030. Between 2010 and 2022, the use of modern bioenergy increased by around 3% per year on average and is on the rise. In addition, biofuel production can be successfully improved through the use of optimal process design and the development of synthetic microbial cells with planned malfunctions of internally residing genes and/or other sources of gene expression (microalgae species) or systems biotechnology (for global cellular information) and synthetic and systems biology (bacterial or yeast species).

III. DECONSTRUCTION AND SEPARATION

Deconstruction Division will investigate specific microbial communities. In order to create engineered microbial communities, organisms, pathways, and enzymes that efficiently depolymerize polysaccharides into monosaccharides and depolymerize and catabolize lignin into intermediates that can be converted into biofuels and bioproducts (US Department of energy). Removal of lignin and a decrease in cellulose crystallinity are frequent elements that have been demonstrated to enhance biomass deconstruction under various pretreatment procedures (Gao et al., 2014). Diverse substances, including but not limited to ammonia (Sousa et al ., 2016), ionic liquids (George et al.2015), diluted acids (Langan et al. 2014), and deep-eutectic solvents , have demonstrated some effectiveness in breaking down biomass. But it has recently been demonstrated that using multifunctional cosolvents is a particularly efficient and cost-effective way to dissolve plant cell walls and present the products in a way that makes them suitable for conversion into high-value products like biofuels. However, little is known about the interactions between co-solvents and biomass, as well as the mechanisms of co-solvent pretreatment. As a result, to produce highly digestible pretreated solids at the expense of significant total sugar losses, expensive solvent recovery techniques, or excessive solvent slippage during liquid-solids separations, these methods are typically performed under high co-solvent and acid concentrations and/or high reaction temperature conditions (Shuai et al., 2016; Agnihotri et al., 2015). This encouraging finding highlights the value of a separation-free process in which IL pretreated biomass is converted into biofuels or bioproducts with no intermediate separation steps between conversion unit operations While ethanol production has been demonstrated in the presence of concentrated ionic liquids, no process has yet demonstrated production of advanced biofuels such as molecules suitable for diesel and jet fuel under such conditions, and no fermentation process has yet demonstrated conversion of both pentose and hexose sugars in the presence of concentrated ionic liquids (Eric Sundstrom et al.,2018).

IV. CONCLUSION

Bioenergy is a critical component of the renewable energy mix in ensuring a consistent energy supply. Carbon absorbed by plants through photosynthesis is contained in biomass. When this biomass is burned to generate electricity, the carbon is simply released into the environment, making modern bioenergy a promising near-zero-emission fuel. According to conservative scenarios, future bioenergy shares will be in the range of 15-20%, moderate scenarios, 30-45%, and high scenarios, 50-95%. High proportions of electricity are thought to be the easiest to obtain, high percentages of heating/cooling are the hardest to obtain, and high shares of transport energy are the most unpredictable. All energy scenarios show a combination of energy supply technologies along with rising energy demand and rising levels of energy efficiency.

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