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Editorial

2G Bioethanol

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Fossil fuels including coal, oil and natural gas, are currently the world's main energy sources. Formed from organic material from ancient times, they were an indisputable source of energy over six decades ago until the energy crisis in the 1970s. The dramatic increase in oil prices at this time, along with increasing evidence of the links between climate change and greenhouse gas (GHG) emissions have awakened the interest in alternative energy sources. In recent years, bioethanol has become a promising alternative to fossil fuel in the transportation sector. It is generally classified into 1st, 2nd and 3rd generation. The 1st generation is produced on a commercial scale worldwide, using mainly corn, sugarcane and wheat, but it can also use sweet potato, cassava and sweet sorghum. Its production amounted to over 13 billion gallons in 2007 and to 27 billion gallons in 2017.

The United States is the world's largest producer of ethanol, having produced nearly 16 billion gallons in 2017 alone. Together, the U.S. and Brazil produce 85% of the world's ethanol [1]. The vast majority of U.S. ethanol is produced from corn, while Brazil primarily uses sugarcane. However, geographical limitations and the food versus fuel debate on the production of 1st generation ethanol has prompted a search for alternative sources including the use of the lignocellulosic materials since the demand for bioethanol continues to increase. Lignocelulosic biomass is considered a promising alternative to produce biofuels as a result of its abundance, low cost and carbon-neutrality. In 2018, 19.29 billion gallons of bioethanol were produced in the US, but only around 7 billion gallons were the 2nd generation ethanol [2]. In the same year, Brazil produced 208 million gallons of bioethanol, but less than 0.16 million gallons were 2G ethanol [3]. This means that, even though the production of 2nd generation ethanol on a commercial scale is already a reality, improvements are still needed in order to reach a more economically-competitive technology. Since the inauguration of the first commercial-scale 2G plant, in 2012, nine more have opened around the world, of which some, not surprisingly, are failing, while others are progressing. Most of them are located in USA, but there is also plants in Brazil, China and in a few countries in Europe [4].

One of the main challenges is the pretreament, which is important to make the polysacharides more accessible by separating lignin from cellulose and hemicellulose in preparation for hydrolysis and fermentation into ethanol. This step isn't fully understood and the equipment used is expensive. GraBio in Brazil started up a cellulosic ethanol plant in 2014 but it suspended operations from 2016 to 2019 due to technical difficulties in the pretreatment stage. The hydrolsysis step has decreased costs as a result of significant reductions in prices of enzymes in the past years.

Hydrolysis still requires a long time period and presents a risk of contamination, which can increase costs. Another bottoneck of the 2G ethanol production is the fermentation of pentoses, the C5 sugars resulting from the hydrolysis of hemicellulose. There is a lack of organism that efficiently converts all the C5 and C6 sugars to ethanol. Hence, fermentation research has focused on identifying wild or genetically engineered yeast and bacteria capable of fermenting both hexoses and pentoses at productive yields. Consolidaded bioprocessing (CBP) is also being studied nowadays in order to reduce capital costs. CBP combines pretreatment, hydrolysis, and fermentation processes within a single reactor, which could lead to reduction of costs and increasing conversion efficiencies. Efforts are being made to get this technology available on industrial scale.

Therefore, despite the mentioned barriers, the alternative biofuels of today may become the conventional fuels in the future. Reserchers believe that if the current agricultural, industrial and technological obstacles faced today are surmounted, the 2G ethanol can be economically viable by 2025 and can become cheaper than 1G ethanol in 2030. The commercial production of 2G ethanol is a promising technology that could be a reality, particularly as part of a cellulosic biorefinery.

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