

Use of cultivars of low cost, agroindustrial and urban waste in the production of cellulosic ethanol in Brazil: A proposal to utilization of microdistillery



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ARTICLE INFO

Article history:

Received 10 September 2013

Received in revised form

25 December 2014

Accepted 12 May 2015

Keywords:

Biorefinery

Coconuts

Cactus

Small-scale industrial

Sugar-energetic power plants

ABSTRACT

Ethanol production from sucrose from sugarcane allowed Brazil to become a world reference in the production of biofuels. Presenting the 2013/2014 crop harvest of 653,519 thousand tons of sugarcane, thus producing 37,713 thousand tons of sugar and 27,543 thousand m³ of ethanol and generating 91,493 thousand tons of bagasse. However, as referenced since 1970, Brazil could exploit sugarcane waste surpluses in order to use bagasse and straw for ethanol production, but the data presented in the last decade emphasized in a significant direction and on increasing the use of these wastes in the generation of bioelectricity. Currently there are 486 sugar-energetic power plants with the productive capacity of 12.056 MW to the power network (autoconsumption of sugar-energetic power plants corresponds to 50% of the energy produced), representing 8.4% of the Brazilian energy matrix. Therefore, this review reports that the offer of bagasse and straw for ethanol production in industrial scale will be insufficient, thus, arising the need to find possible lignocellulosic materials with the potential to be used for ethanol production, thus allowing the supplemental absence of straw and bagasse sugarcane that could be available according to the locality, both in the rural area as well as in the urban area. Furthermore, the review reports the application of sugarcane wastes in the production of bioethanol, the difficulties encountered in the implementation of cellulosic ethanol power plants based only on the use of bagasse and straw of sugarcane, the possibility to use alternatives of lignocellulosic materials with potential to be applied in Brazil, besides the production of cellulosic ethanol, the production of co-products and by-products using microdistillery, based on the biorefinery context in an efficient manner.

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1. Contemporary situation of Brazilian sugar-energetic power plants

Brazilian sugar-energetic power plants focused only on the production of ethanol and sugar, however, recently attention turned back also to the production of bioelectricity, alcohol chemistry and commercialization of carbon credits [1–4]. That way, it made possible the increase in the offer of products generated by sugar-energetic power plants [2,5]. Furthermore, stands out the global production of cellulosic ethanol as an alternative to ethanol produced based on food sources [5–10], as evidenced by Sastri and Lee [10] (Fig. 1). In Brazil, the production of cellulosic ethanol is being projected, at first, from waste sugarcane [1,5,7,11–13], estimating that the first Brazilian power plants of this type will be in operation in 2014 [14].

The harnessing of the Brazilian energetic potential referring to the straw and bagasse of sugarcane in a short and medium term is directed for electric power production [1,4,5,15–19], considered economically viable in Brazil [1,20], that configures itself like a potential competitor in the destination of straw and bagasse of sugarcane for ethanol production, especially if adopted specific policies such as the energy auctions related to bioelectricity generation.

According to Dias et al. [5], Castro et al. [21] and Menon and Rao [22] the cellulosic ethanol can be competed with the production of bioelectricity, but initially it requires the use integral waste of sugarcane, lower cost of enzymes involved in the process and industrial scale production. However, despite expectations, great uncertainty remains about the performance of cellulosic ethanol production in industrial scale [22], like that the implantation of the power plants in industrial scale is hampered by the absence of public–private funding, derived from the world economic crisis [23,24]. Therefore, this biotechnological route has yet to prove soundness, efficiency and competitiveness.

In 2010, there existed 432 sugar-energetic power plants in activity in the Brazil, whereas 129 were exporting energy to the power network, adding up to 1002 MW [4,25]. In 2012, there were 348 sugar-energetic power plants exporting energy to the power network [26] and currently there are 486 sugar-energetic power plants with the productive capacity of 12,056 MW, representing 8.4% of the Brazilian energy matrix. Presenting the crop 2013/2014

harvest of 653,519 thousand tons of sugarcane, thus producing 37,713 thousand tons of sugar and 27,543 thousand m³ of ethanol (being 12,223 m³ of anhydrous ethanol and 1532 thousand m³ of hydrous ethanol). 91,493 thousand tons of bagasse was generated [26]. In this trend, it has been verified the use of straw and bagasse from sugarcane for the production of electricity [19]. According to Sousa and Macedo [4] bioelectricity presents a potential to supply about 20% of the Brazilian electricity demand by the end of this decade. It is estimated that the production and distribution of bioelectricity in the Brazilian electricity network, through 2021, can be compared to three hydroelectric power plants of Belo Monte, as shown in Fig. 2 [25].

In this context, the Brazilian production of ethanol from straw and bagasse of sugarcane can also be penalized by the adaptive structures of sugar-energetic power plants that use such wastes for the production of electricity, because the Brazilian environmental law places some restrictions on the installations of new sugar-energetic power plants. For example, the State of Mato Grosso do Sul limits the installation of a new sugar-energetic power plant to a minimum radial distance of 25 km between the power plants and limits at 20 km, the distance between the urban area and the power plant. It means that in a few years it will be occupy a majority of permissible areas for implantation of these sugar-energetic power plants, and in the current situation it is designed for the waste of sugarcane for the production of electricity. This destination of waste from sugarcane for the production of electricity in Brazil was also motivated by the delay in implantation of the power plants producing ethanol from these lignocellulosic materials, besides the increase in public–private incentives for the production of bioelectricity [19], therefore reducing the offer of waste of sugarcane for ethanol production. All of these events were also favored by the appellants “energy

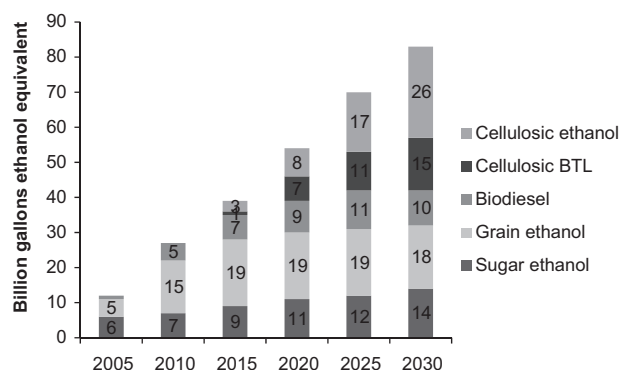


Fig. 1. Total biofuels production by type in the reference scenario. .
Source: [10]

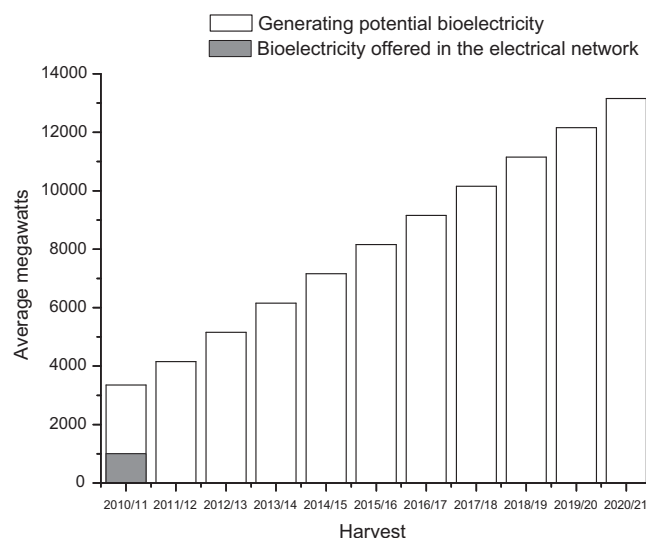


Fig. 2. Market potential of bioelectricity to electrical network – Brazil (2010–2021).
Source: [25]

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