1. Introduction

Worldwide energy demands coupled with a reduction of readily and economically available fossil feedstock and their environmental impacts have resulted in an extensive need for novel and sustainable sources of energy. Lignocellulosic biomass is the unique economic and environmentally acceptable alternative since it is abundant, renewable and low-cost, and does not compete with food and feed applications. Presently, lignocellulosic biomass is one of the most important energy sources, having an estimated annual production of 10–50 billion metric tons worldwide. One great example of the importance of lignocellulosic biomass is wheat straw, which is produced throughout the world as a residue of wheat cultivation. Wheat straw has drawn special attention due to its many interesting features that facilitate its valorization. For instance, it is produced in high amounts and it does not present an excessive added-value. Presently, it is employed in low added-value applications such as animal-feed and bedding, mulch and pulp production. Furthermore, it is considered the agro-industrial residue that represents the uppermost potential for the production of second generation of bioethanol in Europe since its annual production is around 170 million tons per year.

Lignocellulosic biomass has a very heterogeneous composition as it is generally composed of three main fractions: cellulose, hemicelluloses and lignin. Cellulose and hemicelluloses are constituted by polymers of hexosans and pentosans representing 35–50% and 20–40% of biomass, respectively. Lignin is a complex polymer matrix of aromatic alcohols constituting between 10 and 25% of the weight of entire biomass. The aforementioned complex composition and recalcitrant structure of lignocellulosic biomass creates a great challenge for its valorization in the biorefinery framework. In an effort to obtain all benefits of each biomass component, specific technologies are needed to deconstruct them and to make biomass available for further conversion to value-added products. Various physical, chemical, physico-chemical and biological pretreatment technologies have demonstrated to be efficient in deconstruction of recalcitrant structure of biomass increasing its susceptibility to enzymatic-based processes. On the other hand, most of these pretreatments are characterized by low selectivity influencing negatively the production of diverse value commodities at competitive costs. Thus, beyond the need to find alternative sources of energy, the development of novel and more environmentally benign technologies for lignocellulosic biomass processing is still strongly required.

Recently, green technologies such as high-pressure CO₂–H₂O approach have been used in the valorization of lignocellulosic and starch-based biomass to produce a wide-range of chemicals and others value-added products. Recently, Morais et al. published a review where the applicability and effectiveness of high-pressure CO₂ and CO₂–H₂O technology for biomass pretreatment and its potential as alternative to conventional methods such as acid-catalyzed and water-only reactions were...