[4]. Most of the produced bioethanol is considered a first-generation biofuel because the raw material for the process is starch or glucose, coming mainly from the arable land for food production [5]. The major negative social impact of first-generation bioethanol production can be sorted by using Lignocellulosic Biomass as starting material because of effective decoupling with food production. The limitation of the so-called second-generation bioethanol is mainly the relatively low bioavailability of glucose of the feedstock because of the presence of lignin [6], which hinders yield, and it is considered a low-value residue. Many second-generation bioethanol industrial initiatives could fail if the technology gaps are not carefully addressed. A third of the bioethanol world supply was predicted to be produced in 2020, parting from LCW [7], but currently and unfortunately, less than 2% of the market is supplied by this methodology [8]. Most pilot experiences all over the world were unsuccessful at scaling up. Unit integration and system optimization are the ultimate solutions for making the cellulosic ethanol production process [9].

Conversion of agro-industrial and urban wastes (lignocellulosic wastes – LCW) to energy is an innovative approach for waste valorization and management, simultaneously mitigating environmental pollution. Utilizing LCW has economic benefits while addressing the issue of food vs. fuel controversy, being an attractive alternative for disposal of agricultural, forestry, and urban waste [10–14]. Garden and street forest waste is an important lignocellulosic feedstock recognized as a resource [15]. Besides conventional processing methods like burial, microbial composting, and biochar production, biorefineries to produce biogas and bioethanol from garden and forestry waste have attracted global attention [16–19]. In Buenos Aires city, with streets beautifully covered by trees, this type of waste can reach hundreds of tons per day. Although they are partially treated in a city's recycling plant [20] and used for compost and pulping, specific information for optimizing this LCW valorization is relevant for intensifying and diversifying the processes.

There are four basic processes involved in the biochemical production and obtaining of ethanol by yeasts from cellulosic biomass: pretreatment for cellulose separation from lignin (called delignification), enzymatic hydrolysis of cellulose (called saccharification), fermentation, and distillation. The optimization of delignification and saccharification are key to improving fermentation efficiency. The pretreatment of LCW is a key stage to disrupt the recalcitrant structure of lignocellulose [10]. The delignification processes traditionally used in the extraction of cellulose for paper production and the methods that use strong acids and alkalis are not adequate to generate a bioavailable substrate for fermentation [21]. Classical dilute acid pretreatments require high temperatures and the remaining lignin still hinders access to the cellulose fibers [17]. Delignification of LCW strongly facilitates the hydrolysis of holocellulose to fermentable sugars involved in producing biofuels and other bio-based chemicals.

Moreover, at high temperatures, aliphatic acids, and furans toxic for fermenting microorganisms are formed [10,22–24]. Therefore, developing low-temperature pretreatments is important to reduce toxic molecules and energy consumption. The high oxidative mixture of hydrogen peroxide and acetic acid has been suggested as a low-temperature pretreatment with high lignin removal efficiency, leading to significant recovery of fermentable sugars [25–27]. The PoxAc delignification process [27] is based on a mixture of hydrogen peroxide in glacial acetic acid, which allows cellulose to be separated and obtaining high-quality lignin to be used in a variety of applications, such as Supercritical Water Gasification to produce hydrogen [28] and materials for 3D printing [29]. The PoxAc delignification method uses reagents that decompose into harmless compounds produces a substrate that allows better productivity of sugars through enzymatic and biological treatments. In addition, delignified LCW can be used for other purposes, such as fluid rheology modifiers [30], as reinforcement material in composites and biodegradable polymers, as strength additives in textile printing and coating products [31,32], and many more.