
improving cellulase activity for cellulose hydrolysis towards the future production of second generation bio-ethanol

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The limited reserves of fossil fuels have forced attention to the use of renewable biomaterials for energy production, with particular focus on the use of cellulose, for the production of ethanol (second generation bio-ethanol). For this to become viable, a limiting and crucial step is the hydrolysis of cellulose, due to the protection of the sugar molecules against chemical and enzymatic hydrolysis, by the tight packing of cellulose chains in microfibrils and cellulose poor solubility in aqueous solutions. Ionic liquids (ILs), salts that are liquids at room temperature, are an emerging new class of solvents for biocatalysis, with some showing capacity to dissolve cellulose, opening interesting possibilities to render cellulose more accessible to hydrolysis. High pressure (HP), now an established method for cold pasteurization of foods, has also the potential to change enzymes activity and selectivity.

In this work the combined effect of an ionic liquid, [bmim]Cl, and HP (up to 675 MPa) on the activity of one enzyme was studied for the first time (cellulase and carboxymethyl cellulose were used as case-study). The results showed that cellulase activity in the ionic liquid [bmim]Cl at atmospheric pressure is lower

(30 to 50%) compared to buffer and correlates linearly with the decrease of the thermodynamic water activity (a_w) caused by [bmim]Cl. In 10% [bmim]Cl, cellulase activity under pressure varies from equal to 1.7-fold higher (at 100 MPa) the value at atmospheric pressure. These results open the possibility to improve cellulase activity, and possibly of other enzymes, in ILs, by carrying out the reaction under pressure, by combining the peculiar solvent properties of ILs and the effect of HP on enzymatic reactions. In the case of cellulose this can lead to future methodologies to render cellulose hydrolysis viable to produce bio-ethanol.

