A STUDY OF THE INHIBITION OF CELLULASES BY LIGNIN FRAGMENTS

Wood is a renewable resource and a potential feedstock to produce useful chemicals. The enzymatic hydrolysis of wood, which is known as bioconversion of wood for sugars has received a great deal of attention in recent years because the most widely used process, chemical hydrolysis, has several disadvantages. The bioconversion offers a range of advantages for the production of useful sugars. This process produces high yields and has minimal byproduct formation, low energy requirements, mild operating conditions, and also, it does not need to be neutralized prior to the downstream process. For all these reasons the bioconversion is environmentally benign.

Literature suggests that enzymes are deactivated by some lignin degradation products resulting from wood pretreatment. Also, some researchers propose that some of these products activate the enzyme during this process. Once the effect of these lignin-related compounds is identified, the treatments can be applied to neutralize or remove the harmful products from the medium for effective bioconversion. The objective of this research was to identify the effect of lignin-related monomeric compounds on two different cellulases. Seven compounds were tested for cellulase from Aspergillus niger and two compounds were tested for cellulase from Trichoderma reesei.

Three different types of reversible inhibitors, a competitive inhibitor, mixed inhibitors and uncompetitive inhibitors were identified. Among these molecules, vanillic acid activated cellulase from Aspergillus niger towards hydrolysis of cellobiose. None of them produced non-competitive inhibition, irreversible inhibition or had no effect at all on the enzymes. The order of inhibitory effects was p-hydroxyacetophenone, vanillin, resorcinol and p-coumaric acid on the cellulase from Aspergillus niger.

Selected references:
Tejirian, A.; Xu, F. “Inhibition of Enzymatic Cellulolysis by Phenolic Compounds” Enzyme and Microbial Technology 2011, 48, 239.