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Fungal Cellulase/Xylanase Complex and Their Industrial Applications

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Abstract : Microbial cellulase/xylanase have shown their potential application in various industries including pulp and paper, textile, laundry, biofuel production, food and feed industry, brewing, and agriculture. Extremophilic micromycetes and their enzymes that are resistant to critical values of temperature and pH, and retaining enzyme activity for a long time are of great industrial interest. Among strains of microscopic fungi from the collection of S. Durmishidze Institute of Biochemistry and Biotechnology, strains isolated from different ecological niches of Southern Caucasus-active producers of cellulase/xylanase have been selected by means of screening under deep cultivation conditions. Extremophilic micromycetes and their enzymes that are resistant to critical values of temperature and pH, and retaining enzyme activity for a long time are of great industrial interest. Among strains of microscopic fungi from the collection of S. Durmishidze Institute of Biochemistry and Biotechnology, strains isolated from different ecological niches of Southern Caucasus-active producers of cellulase/xylanase have been selected by means of screening under deep cultivation conditions. Representatives of the genera Aspergillus, Penicillium and Trichoderma are outstanding by relatively high activities of these enzymes. Among the producers were revealed thermophilic strains, representatives of the genus Aspergillus-Aspergillus terreus, Aspergillus versicolor, Aspergillus wentii, also strains of Sporotrichum pulverulentum and Chaetomium thermophile. As a result of optimization of cultivation media and conditions, activities of enzymes produced by the strains have been increased by 4 -189 %. Two strains, active producers of cellulase/xylanase – Penicillium canescence E2 (mesophile) and Aspergillus versicolor Z17 (thermophile) were chosen for further studies. Cellulase/xylanase enzyme preparations from two different genera of microscopic fungi Penicillium canescence E2 and Aspergillus versicolor Z 17 were obtained with activities 220 U/g /1200 U/g and 125 U/g /940 U/g, correspondingly. Main technical characteristics were as follows: the highest enzyme activities were obtained for mesophilic strain Penicillium canescence E2 at 45-500C, while almost the same enzyme activities were fixed for the thermophilic strain Aspergillus versicolor Z 17 at temperature 60-65°C, exceeding the temperature optimum of the mesophile by 150C. Optimum pH of action of the studied cellulase/xylanases from mesophileic and thermophilic strains were similar and equaled to 4.5-5.0 It has been shown that cellulase/xylanase technical preparations from selected strains of Penicillium canescence E2 and Aspergillus versicolor Z17 hydrolyzed cellulose of untreated wheat straw to reducible sugars by 46-52%, and to glucose by 22-27%. However the thermophilic enzyme preparations from the thermophilic A.versicolor strains conducted the process at 600C higher by 100C as compared to mesophlic analogue. Rate of hydrolyses of the pretreated substrate by the same enzyme preparations to reducible sugars and glucose conducted at optimum for their action 60 and 500C was 52-61% and 29-33%, correspondingly. Thus, maximum yield of glucose and reducible sugars form untreated and pretreated wheat straw was achieved at higher temperature (600C) by enzyme preparations from thermophilic strain, which gives advantage for their industrial application.

Keywords : cellulase/xylanase, cellulose hydrolysis, microscopic fungi, thermophilic strain
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