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Corncob pretreated with the combination of electron beam irradiation and enzymes to enhance fermentable sugars for biofuel production

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Lignocellulosic biomass pretreatment technologies have been taken up as a global challenge as it comprises to increase enzyme accessibility to biomass and yields of fermentable sugars. The reducing sugars released from pretreatment of the corn cob can be converted into biofuels. Corncob is a lignocellulosic material composed of cellulose, hemicellulose, and lignin. Cellulose and hemicellulose are polysaccharides constituted of simple sugars (hexoses and pentoses). However, these sugars are difficult to access, due to the presence of lignin, which is a polyphenolic molecule that provides a high recalcitrance to plant tissue. An appropriate biomass pretreatment disrupts the hydrogen bonds in crystalline cellulose, breaks down cross-linked matrix of hemicelluloses and lignin, and raises the porosity and surface area of cellulose for subsequent enzymatic hydrolysis. There are several pretreatment methods including, physical pretreatment (electron beam irradiation, grinding and milling, microwave, and extrusion), chemical pretreatment (alkali, acid, organosolv, ozonolysis, and ionic liquid), physico-chemical pretreatment (steam explosion, liquid hot water, ammonia fiber explosion, wet oxidation, and CO_2 explosion), and biological pretreatment. This study evaluated electron beam irradiation (EB) in combination with enzymatic hydrolysis on corncob at different grain size to produce fermentable sugars. Dry biomass samples after characterization were exposed to EB radiation doses of 0, 30, 50, 70, 100, and 200 kGy. Enzymatic hydrolysis of the pretreated biomass samples were conducted using 10% of solid in Erlenmeyer flasks (125 mL) containing of 50 mL of medium prepared with sodium citrate buffer (50 $mmol.L^{-1}$, pH 4.8), CellicCTec 2 25.50 FPU/g $_{\text{dry lignocellulosic material}}$) and Tween 80 (9.8 % w/w) under 200 rpm at 50 °C. using the Cellic® CTec2 from Novozymes. The structural changes and degree of crystallinity of the pretreated biomass were studied by FTIR, DRX, DSC, TG and SEM analyses. Corncob *in natura* showed 6.3 % extractives, 40.3 % cellulose, 31.8 % hemicellulose, 17.3 % lignin, and 0.7 % ash. The highest conversion of cellulose to glucose (44.2%) was by using EB radiation doses of 200 kGy and reduced corn cob grain size. Significant improvement in the enzymatic saccharification (80.4%) of the EBI exposed biomass was observed compared to control. The sugars released can be converted to biofuel or another bioproduct. The EB in combination with enzymatic hydrolysis of corncob is an environmentally sound biomass pretreatment.

Keywords: Corn cob, **electron beam irradiation, enzymatic hydrolysis, fermentable sugars**

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