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Development of efficient bioprocesses for improved bioethanol production from a mixture of food wastes

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Abstract:

Lignocellulosic bioethanol production now-a-days is gaining increasing interest due to global warming, hike in oil price etc. But there are several technological and other challenges associated with bioethanol production. Technological challenges are development of efficient pretreatment step which can significantly degrade lignin without altering carbohydrates, efficient hydrolysis step and development of fermentation step which can utilize both pentose and hexose sugars. The present study has focused on bioprocess development for bioethanol production from a mixture of food wastes (spinach, cabbage, peels of onion and orange). First liquid hot water (LHW) pretreatment of food waste was optimized by varying different parameters (temperature, incubation time and substrate concentration). Maximum reducing sugar yield (525.60 mg/gram dry substrate) was found at substrate concentration 10% (w/v), temperature 160 oC and incubation time 30 min. After optimization, LHW pretreated biomass was characterized using Fourier transformed infrared spectroscopy (FTIR), X-ray diffraction (XRD), Scanning electron microscopy (SEM) and biochemical composition analysis. Further, pretreated biomass was hydrolysed using whole cells of Fusarium incarnatum KU377454 (locally isolated strain) without addition of any enzymes. It showed maximum reducing sugar yield of 580.95 mg/gram dry substrate) within 3 days of incubation at 30 oC. The produced sugar hydrolysate was further fermented using co-cultures of hexose fermenting strain (Sacchromyces cerevisiae) and pentose fermenting strain (F. oxysporum). Maximum ethanol production (3.25%, v/v) was observed after 48 h of incubation at 35 oC. The present study, reports development of efficient thermal pretreatment without addition of any chemicals. Further carbohydrates, part of pretreated biomass were converted into reducing sugars by whole fungal strain without the use of any costly chemicals. Lastly, fermentation process was optimized using co-culture strategy which yielded maximum ethanol from both pentose and hexose sugars. This study can be useful for commercial bioethanol production from food waste.

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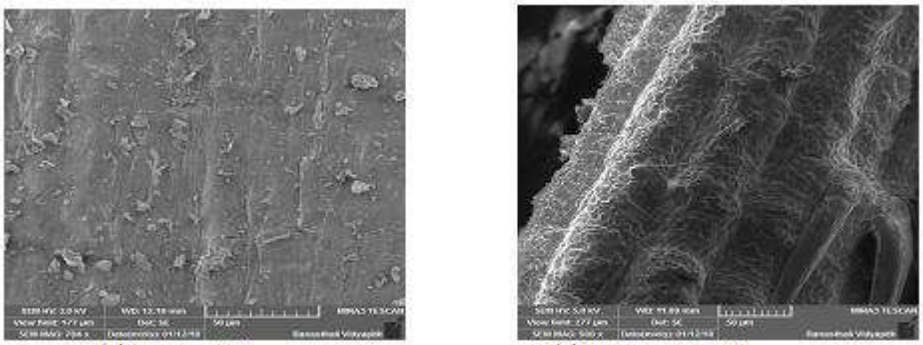

(a) Untreated biomass (b) LHW pretreated biomass

Figure 1: SEM image of (a) untreated and (b) LHW pretreated biomass

Biography:

Dr. Vinay Sharma, currently Director, Amity Institute of Biotechnology and Dean Academics at Amity University Rajasthan has over 35 years experience of teaching and research in Plant Sciences/ Biotechnlology at I.I.T. Roorkee and later at Banasthali Vidyapith. He has delivered over 100 invited/ keynote lectures and has chaired sessions at many national and international forums in India and abroad. He had extensive international research experience as Postdoc/ Visiting Professor at many institutions including Max Planck Institute, Koeln, Technical University, Darmstadt, Germany, University of Central Florida, USA and others. He has published over 300 research papers, has authored 6 books and has mentored 55 doctoral students. He has been honoured with several prestigious fellowships and awards in India and abroad including Fellow of National Academy of Sciences. He has keen interest in Plant Biology (Plant Stress/ Plant Informatics)/ Biotechnology and his current major research focus is on Biofuels (lignocellulosic bioethanol/ biodiesel).