EXECUTIVE SUMMARY Of MINOR RESEARCH PROJECT

Project title

MICROBIAL CONVERSION OF CELLULOSIC WASTES FOR SUSTAINED ENERGY PRODUCTION

(UGC Letter No: MRP-6326/15 (SERO/UGC) dated 31.03.2015)

Submitted To

ज्ञान-विज्ञान विमुक्तये

University Grants Commission

Ministry of Human Resource Management,

Govt. of India

Submitted by

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SELVAMM ARTS & SCIENCE COLLEGE (Autonomous)

(Nationally Re - Accredited at 'A' Grade by NAAC)

UGC Recognized 2(f) and 12(B) Institution

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Tamilnadu - South India

Objective of the Project:

1. Identification of suitable cellulosic wastes for microbial conversion agricultural residues (Paddy straw), Aquatic Weed wastes (Ipomoea), fountain trees (Spathodeaum) and unwanted plant materials (Water hyacinth).
2. Screening based on the enzymology of microorganisms to biodegrade various cellulosic wastes.
3. Pretreatment methods (pH, temperature, pressure, air and additives) to increase the biodegradability of different cellulosic wastes.
4. Studying the fermentation parameters (Physical - Steam explosion, chemical - Alkali hydrolysis & Biological -Enzymatic hydrolysis) for the ethanol production.
5. Immobilization technology to increase the process efficiency for bio-ethanol production.

Summary of the findings:

Fuel bio ethanol burns cleaner than gasoline, since derived from renewable agricultural products and creates local jobs and income. Agricultural residues are sustainable resources to meet the nation's fuel needs. The caution should also be taken since the technology for cellulosic feedstock conversion to ethanol is still evolving. When different scenarios were considered, a positive net return in terms of feed stock conversion to ethanol was observed for Spathodea wastes, water hyacinth and paddy straw.

The triple inoculants consortium developed in this study consists of *Aspergillus fumigatus* ,*Penicillium digitatum* and *Trichoderma reesei* showed maximum production of the entire cellulolytic enzymes in the growth medium containing Spathodea, water hyacinth Ipomoea and paddy straw.

Cellulosic crop residues were subjected to alkali (NaOH) treatment at 1.5 per cent concentration for 10 h, acid (H_2SO_4) hydrolysis with 0.2 N concentrations for a period of 10 h and 3ml of crude enzyme for a period of 10 h liberated higher fermentable sugars from the wastes selected for the study.

Cellulosic hydrolysates containing the reducing sugars were further fermented with selected Saccharomyces *cerevisiae* and *Zymomonas mobilis* to get ethanol. The pH of 6.5, temperature level of 35°C and inoculums size of 10 per cent were ideal for *Saccharomyces cerevisiae* fermentation of cellulosic hydrolysate.

The ethanol yield obtained with optimized parameters was 23.56 g l^{-1} for Spathodea, 22.78 g l^{-1} for water hyacinth, 21.56 g l^{-1} for Ipomoea and 20.87 g l^{-1} paddy straw respectively. Cellulosic crop residues using *Zymomonas mobilis* were optimized at the pH of 6.5, temperate level of 35°C and inoculums size of 10 per cent.

The studies on the effect of co-immobilized and immobilization of fermenting microorganisms on the ethanol yield revealed that the co-immobilized system with yeast and bacteria gave ethanol yield of 23. 89 g $l^{-1}$for Spathodea, 22.86 g l^{-1} water hyacinth, Ipomoea 21.89 g l^{-1} and 20.09 g l^{-1} paddy straw respectively.

The studies revealed that the higher ethanol tolerance of *Saccharomyces cerevisiae* and *Zymomonas mobilis* in 10 per cent of selected cellulosic crop residues.

In the kinetic analysis, the fermentation efficiency and ethanol productivity was higher in *Saccharomyces cerevisiae* and *Zymomonas mobilis* from the substrate of Spathodea followed by water hyacinth Ipomoaeand paddy straw respectively.

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Output/Achievement of the project

One paper has been published; one paper are **sent** for but not yet published. After publishing they will be uploaded on the college website and **one oral** presentation was done.

Publication from the project:

P. Udhayaraja1*, J. Sriman Narayanan2 and M. Banupriya3 (2017) ISOLATION AND Optimization of cellulase enzyme from cellulosic fungi using sustainable energy production. 3 - 6– 2017:1328 – 1334. ISSN: 2454-1370

Contribution to the Society:

The renewable fuels industry is recovering from the commodity price shocks of 2008 and severe recession. The ethanol industry continues to make a significant contribution to the economy in terms of final demand, and displacement of imported crude oil. Continued expansion of the ethanol industry will confirm the industry's position as the original creator of green jobs and its dependence on fossil fuels.

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