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RECYCLING WASTE SMS AS A SOURCE OF FUEL BIOETHANOL

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ABSTRACT

***P. sajor-caju* spent mushroom substrate from agrowaste was pretreated with 2% NaOH with heating as first pretreatment and microwave as second pretreatment followed by fermentation using 2%, 4%, 6% baker's yeast for 2 to 8 days duration. Special additions by mushroom alone, (Mushroom, Jaggary (5g, 10g, 15g each) in combination), (Mushroom, Mahua flower (5g, 10g, 15g each) in combination) was done randomly at 40 ºC I pretreatment 4% 6 days sample at fermentation step. Extracted bioethanol was estimated using titrimetric as well as spectrophotometric methods. Random samples were used for GCMS estimation method. Also, the surface alterations and cellulose crystallinity were studied using SEM and XRD respectively, 3 times enhancement in bioethanol production was recorded by addition with mushroom+ jaggary (15g each) followed by 2.85 times increase with addition of mushroom + jaggary (10 g each)**

KEY WORDS : Spent mushroom substrate, Bioethanol, Mushroom.

INTRODUCTION

Declining petroleum reserves is an emerging problem. There placement by alternative sources is the need of hour (Bayrakci and Kochar, 2014). Estimated global energy production from biomass is ten times more than annual petroleum production (Binder and Rainer, 2010). Edible portion of food crops are used for first generation biofuel production (Patni *et al.*, 2013). Each kilogram of mushroom crop produces 5 kg of spent mushroom substrate (Sendi *et al.*, 2013). Thus, recycling of waste SMS, a potential source of energy can be converted to bioethanol over whelming the problem of food verses fuel controversy.

MATERIALS AND METHODS

Spent mushroom straw preparation

The spawn of mushroom *Pleurotus sajor-caju* was obtained from Agriculture College, Pune and P.K.V., Akola. The different agrowastes *viz.* Wheat *(Triticum aestivum)*, Mung *(Phaseolous radiatus)*, Tur *(Cajanus cajan)*, Soybean *(Glycine max)* were collected from local farms. The substrate straw and beds were prepared according to the procedure described by Bano and Nagarajan (1976) in 15 different combinations. The spent mushroom substrate was collected, mixed. It was sun dried and oven dried for further estimations.

Alkali Pretreatment

Conventional alkali pretreatment and microwave assisted alkali pretreatment were done with 2% NaOH (Zhu *et al.*, 2006)

Fermentation

All the above pretreated substrates were fermented at 30 ºC and 40 ºC using 2%, 4% and 6% baker's yeast with fermentation duration of 2 to 8 days. The resulting fermentation mixture was distilled out at 72 ºC and collected the distillate for further estimations. Special additions such as mushroom (5g, 10g, 15g), Jaggary with mushroom (5g, 10g, 15g), mahua flower with mushroom (5g, 10g, 15g) were done at the level of fermentation in randomly selected samples for estimating the change in bioethanol content with respect to control sample for better concentration of bioethanol.

Estimation of Ethanol

Titrimetric Method : Estimation of Alcohol content in Wine by Dichromatic Oxidation followed by Redox Titration (Jessica Ferguson, *www.sirromet.com)*

Spectrophotometric method : Colorimetric method for the estimation of ethanol in alcoholic drinks (Sumbhate *et al.,* 2012).

iii) Random sampling was done for GCMS estimation.

RESULTS AND DISCUSSION

In the present experimental study, the bioethanol estimation by titrimetric method recorded ethanol in the range at 30 °C (10g/ L to 50 g/L heating pretreatment), 30 °C (12g/ L to 40 g/ L microwave pretreatment), at 40 °C (24g/ L to 49 g/ L heating pretreatment), 40 °C (25g/ L to 46 g/ L microwave

Estimation of ethaonol by Titrimetric Method

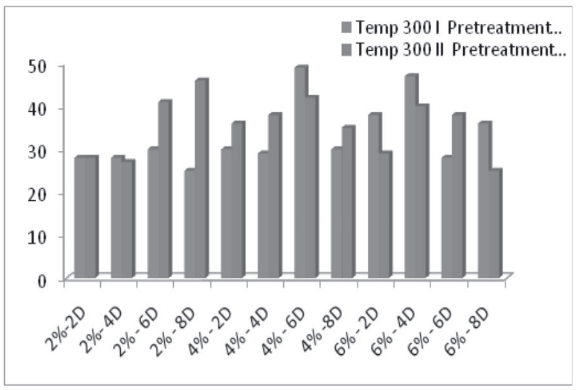


Fig. 1. Estimation of Ethanol in *P. sajor-caju* SMS.

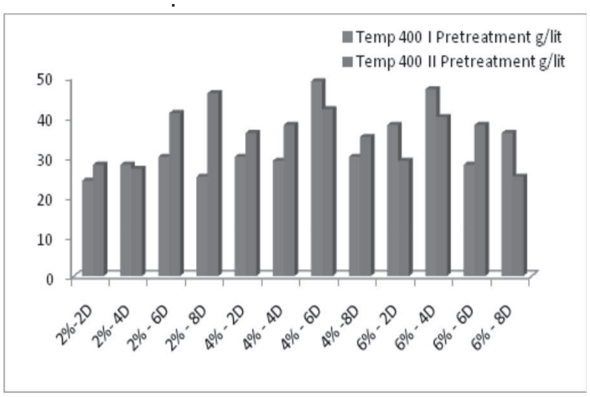


Fig. 2. Estimation of Ethanol in *P. sajor-caju* SMS.

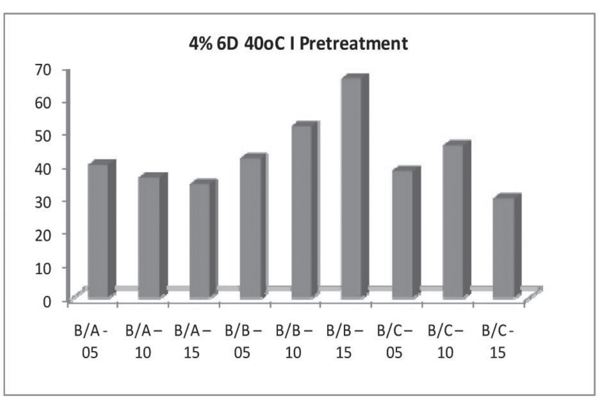


Fig. 3. Estimation of Ethanol in *P. sajor-caju* SMS.

Estimation of ethaonol by Spectrophometric Method

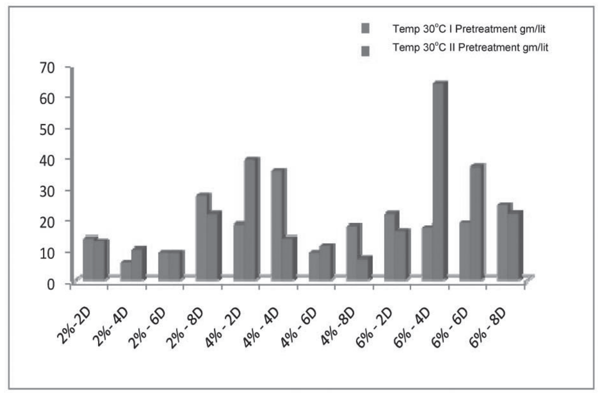


Fig. 4. Estimation of Ethanol in *P. sajor-caju* SMS.

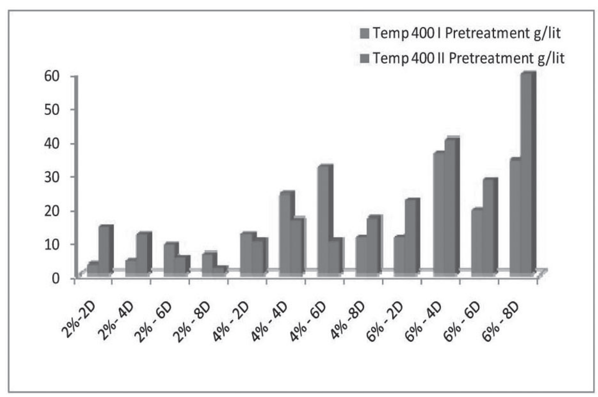


Fig. 5. Estimation of Ethanol in *P. sajor-caju* SMS.

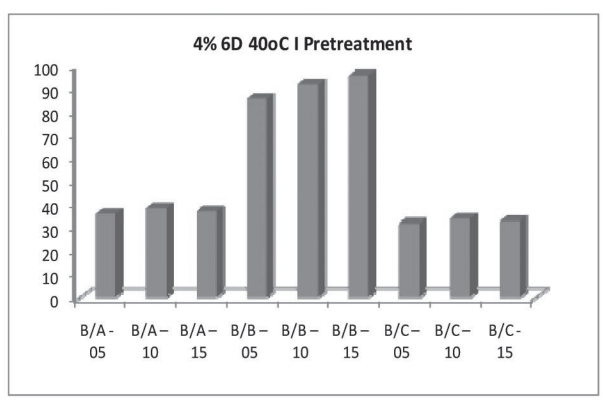


Fig. 6. Estimation of Ethanol in *P. sajor-caju* SMS.

GC-MS spectra of (sample code B) *P. sajor-caju* SMS

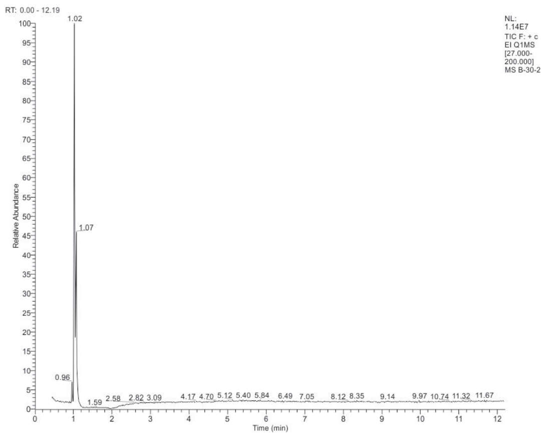


Fig. 1. GC-MS spectra of B/30-I (*P. sajor-caju* 2% 4D).

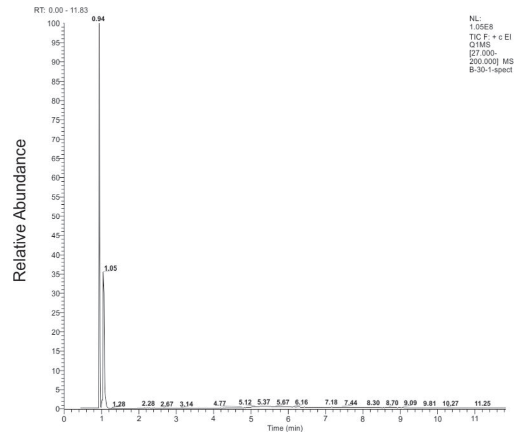


Fig. 2. GC-MS spectra of B-30-I (*P. sajor-caju* 4% 4D)

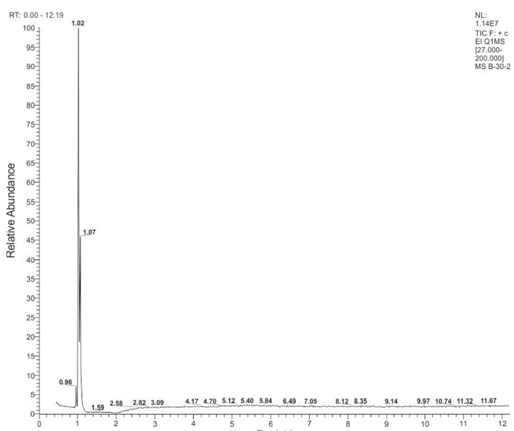


Fig. 3. GC-MS spectra of sample B/30-II (*P. sajor-caju* 4% 8D).

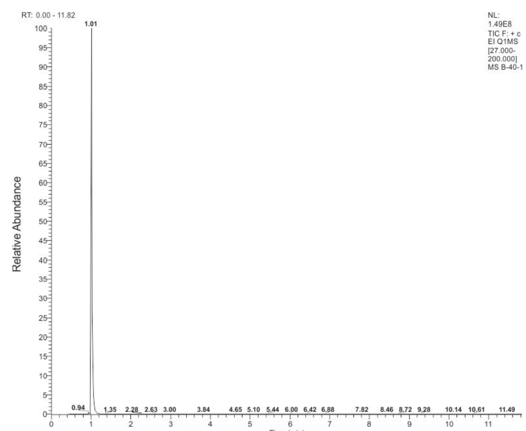


Fig. 4. GC-MS spectra of sample B/30 II (*P. sajor-caju* 6% 4D).

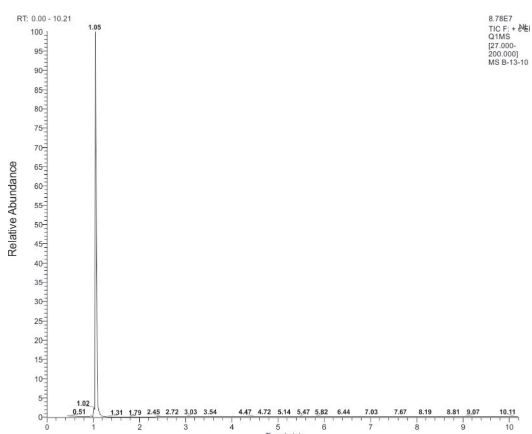


Fig. 5. GC-MS spectra of sample code B-40 I (*P. sajor-caju* 4% 6D)

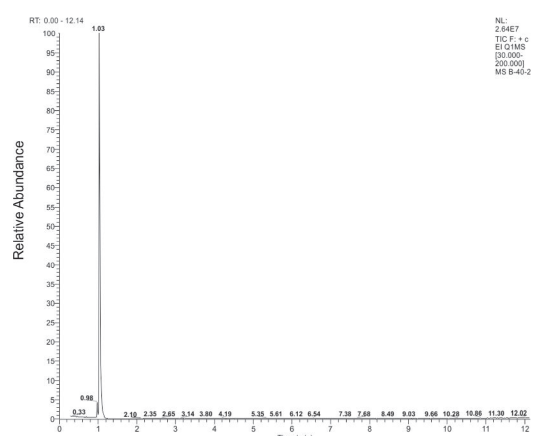


Fig. 6. GC-MS spectra of sample B-40-II (*P. sajor-caju* 4% 2D).

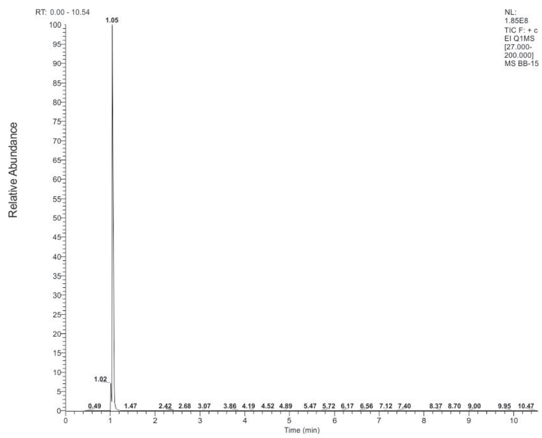


Fig. 6. GC-MS spectra of sample B 40II (*P. sajor-caju* 6% 8D).

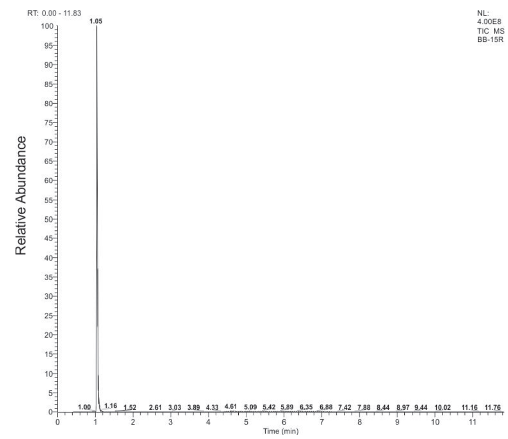
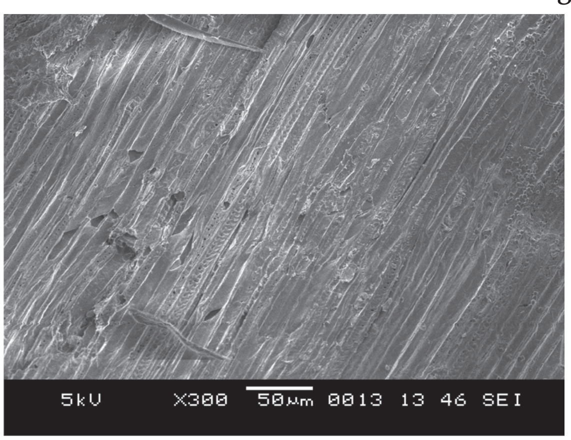


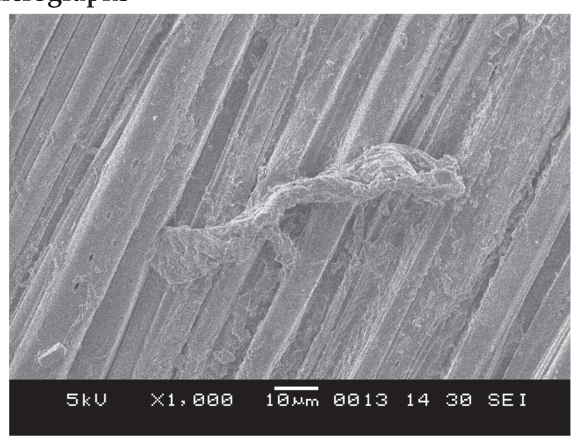
Fig. 7. GC-MS spectra of sample code BB-15 40I (*P. sajor-caju* 4% 6D with additives (15g Mushroom+ 15g Jaggary).

pretreatment). Whereas, in spectrophotometric method the results are in the range at 30 °C (6.0g/ L to 36.0 g/ L heating pretreatment), 30°C (7.0g/ L to 64.0 g/ L microwave pretreatment), 40 °C (3.0g/ L to 36.0g/ L heating pretreatment), at 40 °C (2.0g/ L to 60.0g/ L microwave pretreatment). GCMS method of ethanol estimation for random samples gave similar results to spectrophotometric analysis. Thus, confirming the spectrophotometric method for analysis. Special additions were done at

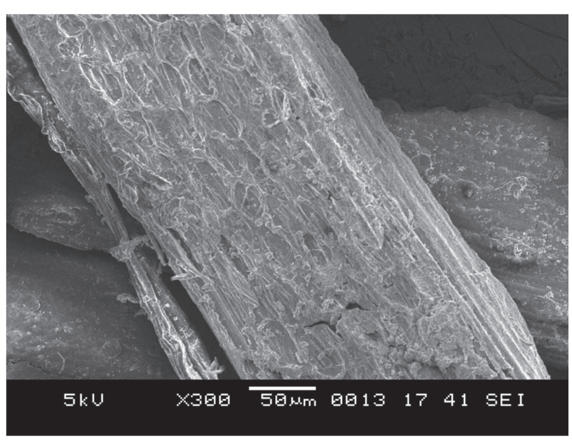
Scanning Micrographs



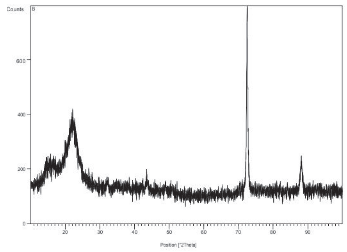
B-*P. sajor-caju* SMS



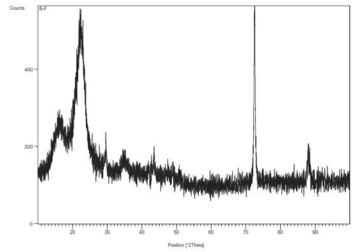
B/F- Fermented *P. sajor-caju* SMS (30°C I 4%2D)



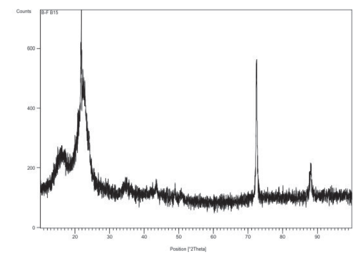
P-Agrowaste



B-*P. sajor-caju* SMS



B/F- Fermented *P. sajor-caju* SMS (30^{o}C I 4%2D)



B/F- B15 Fermented *P. sajor-caju* SMS with additives (40^{o}C I 4% 6D)

temperature 40 ^{o}C, heating pretreatment in 4% 6 days sample at fermentation level with resulting higher bioethanol yield in case with addition (Mushroom + Jaggarry (15 g. each), 96.0 g/L) followed by 92.17 g/ L with addition of Mushroom + Jaggary (10 g each) from basic value of 32.0 g/ L.

Thus the boost up of bioethanol with 3 times for (Mushroom + Jaggary (15 g each) and 2.9 times for special addition of Mushroom+ Jaggary (10 g each) was recorded. The difference of results in estimation by titration method may be due to already much biodegraded lignin content in SMS (Patil *et al.,* 2009) and interference of phenolic compounds in the mixture. The SEM study of plain agrowaste compared with SMS and fermented samples showed that the surface of untreated (control) sample is rough while the surface of fermented sample is relatively smooth. The comparison of cellulose crystallinity in XRD study showed a decrease in crystallinity in fermented samples.

After pretreatment by dilute acid followed by fermentation with *S. cervisae,* the maximum ethanol yield was recorded on sugar cane baggase (11.90g/ L), followed by wheat straw (9.56 g/L), rice straw (8.84 g/L), ragi straw (7.01g/L) and water hyacinth (6.19 g/ L) (Puttaswamy *et al.,* 2016). Bioethanol content of 6.48 g/L was observed in spent paddy straw by using *P. mushroom* (Koshy and Nambison, 2012). In our research, the additives Mushroom + Jaggary prove to be better in giving enhanced ethanol yield.

CONCLUSION

We can conclude that the renewable lignocellulosic biomass such as waste *P. sajor-caju* SMS can be used as potential source of raw material for 2nd generation bioethanol production along with special additions of [Mushroom + Jaggary (15 g each), (10g each)] which give tremendous enhancement in bioethanol production of 3 times and 2.85 times respectively for recycling and reuse without external use of costly enzymes.

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