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Bioethanol Production from Office Waste Paper

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Abstract: In this study, office waste paper was utilized as the raw material for production of bioethanol. Experimental studies have been carried out cellulose to sugar by acid hydrolysis. Acid hydrolysis of waste paper to sugar was carried out 121°C with 5%(v/v) sulfuric acid with the volume of 100ml, 200ml and 5,10,15 g of office waste paper to obtain the best yield of hydrolysate. After adjustment of pH with 5M of sodium hydroxide solution, fermentation was investigated using Saccharomyces Cerevisiae to convert sugar to bioethanol and produced 0.033 g/ml of maximum sugar with 150 rpm for overnight at room temperature. The viability of cell was not the only factor influencing fermentation. The operation time for hydrolysis, adjustment of pH, amount of yeast and rate of aeration during fermentation a was a key interactive factor resulting in ethanol accumulation.

Keywords: office waste paper, acid hydrolysis, bioethanol , Saccharomyces Cerevisia

1. INTRODUCTION

In this study, bioethanol from office waste paper is produced from renewable source. Production from second generation is more benefit because of the consumption of waste residues. Office waste paper from office and photocopy service waste is readily available. Therofore it is attractive for producing second generation bioethanol. The conversion of office waste paper into ethanol is more useful because it is rich in carbonhydrate.(1)

2. LITERAVIEW

Since consumption of paper was increasing for a long time, and the amount of paper going into landfills was increased. And then has become a severe problem for disposal in developed and developing countries.. Bioethanol can be produced from sugar source, starch source and cellulose source. Paper is cellulose source, which is substainable, rewnewable source and reduce the landfill problem.(4)

The technology for bioethanol production includes acid hydrolysis or enzymatic hydrolysis, pH adjustment, fermentation and distillation. The hydrolysis of office waste paper with enzyme is difficult because of consisting of hemicelluloses and lignin. Dilute acid hydrolysis is fast, easy and acid losses are not important.(1) The present research is based on bioethanol production from waste office paper. This feedstock results to be attractive for bioethanol production due to its availably. Despite of recycling efforts have been strengthened in the last years, the recycling rate is about a 65%, since the quality of the paper decreases with the recycling process . Then, waste office paper could be a suitable raw material for obtaining bioethanol.

3. EXPERIMENTAL

3.1 Yeast Activity Test

Activity of yeast was determined in 250 ml of Erlenmeyer flasks with sugar solution. After Saccharomyces Cerevisia was transferred into the sugar solution with 150 rpm at room temperature, carbon dioxide gas was appeared within 15 minutes.

3.2 Hydrolysis with Dilute Sulfuric Acid

Waste office paper collected from office and photocopiers was used. The paper was cut into pieces. The 5% of sulphuric acid 100 mL solution was poured into 250 mL Erlenmeyer flasks which the 10 g of paper was put. The samples of flasks were placed into autoclaves. At the temperature of 121°C, the hydrolysis was carried out various reaction time, acid concentration, and paper weight. The product take out from the autoclave was cool .and then filtered by filter paper to separate the liquid and solid. The product from hydrolysis was measured by refractor meter for sugar content and by pH meter for pH value.

3.3 Addition of NaOH Solution

After filtration all the samples were neutralized by adding 5M of Sodium hydroxide solution to obtain pH range 4.5 to 5 at room temperature.

3.4 Fermentation

For fermentation, the strain of *Saccharomyces cerevisiae* were added in the different condition 0.5 g,1g, 1.5g, 2g,2.5 g respectively at 30° C and 150 rpm for overnight . After one night, the product was measured for ethanol content, pH value and density.

4. Result and Discussion

The complex experimental results are shown in Table1. The result suggests that the sugar information depends on the effect of concentration of acid and paper weight in the hydrolysis. The optimized condition for production of bioethanol was 10g of office paper,5% H_2SO_4 100mL,at 121°C and 60 minutes of content time. By using Response Surface Method(RSM), the increase of sugar brix and amount of yeast led to the increase of ethanol yield. On the other hand, the temperature of distillation also affected the purity of ethanol

As shown in figure(2) the response of surface diagram, the increase of temperature and sugar brix % achieved to the increase of the percentage of ethanol. The highest yield percentage of ethanol was obtained with sugar brix 10.2 % at the amount of yeast 2g.

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1.99307	97.36%	92.62%	57.82%

The R^2 values for the two models are 97.36% and 92.62%, indicating that the three factors accounted for over 95% of the variation of sugar Brix%, amount of yeast(g) and temperature of distillation (°C). This indicates that the fitted model is adequate. The use of graphical representations of the empirical models shown in figure (1) to facilitate interpretation of factor effects on three factors and α=0.05.

The initial concentration of sugar brix was about 0.1062 g of sugar per mL of solution, the pH was 0.92. The adjustment of hydrolysate with 5M of NaOH solution was increased the pH of solution. The amount of NaOH solution was resulted on sugar content. Since the percentage of ethanol obtained by the fermentation of high content sugar brix with amount of yeast in the optimized culture medium, the amount of yeast was varied within 1.5 g to 2.5 g range. There was chosen for the best fermentation with 2 g of yeast.

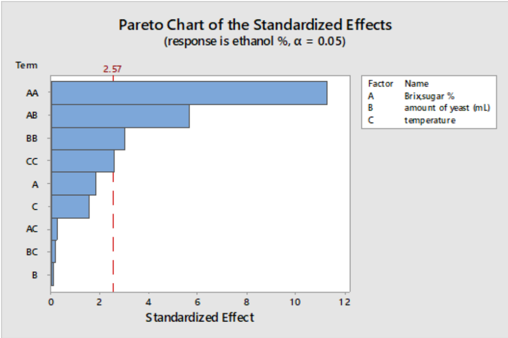

Figure 1.Parto Chart of the Standardized Effects

sample	Paper wt(g)	5%H_2SO_4 (mL)	Sugar%, Brix	Sp.gr	g of sugar/ml of solution	pH	Amount of yeast(g)	Ethanol % after fermentation for 24 hr
1	5	100	9.6	1.0384	0.0997	1	1.5	7
2	5	100	9.6	1.0384	0.0997	1	2	13.7
3	5	100	9.6	1.0384	0.0997	1	2.5	17.7
4	5	200	3.5	1.0137	0.0354	0.87	1.5	1.8
5	5	200	3.5	1.0137	0.0354	0.89	2	2
6	5	200	3.5	1.0137	0.0354	0.89	2.5	2
7	10	100	10	1.04	0.104	0.93	1.5	7
8	10	100	8	1.0318	0.0825	0.96	2	6
9	10	100	10	1.04	0.104	0.93	2.5	18.9
10	10	100	10.2	1.0409	0.1062	0.92	1.5	9
11	10	100	10.2	1.0409	0.1062	0.92	2	19.5
12	10	100	10	1.04	0.104	0.92	2.5	19
13	10	100	10	1.04	0.104	0.93	1.5	9.3
14	10	100	9.7	1.0388	0.1001	0.95	2	18.6
15	10	100	10.1	1.0404	0.1051	0.93	2.5	13
16	10	100	10	1.04	0.104	0.93	1.5	7.1
17	10	100	10.1	1.0404	0.1051	0.93	2	18.3
18	20	200	4	1.0157	0.0406	1.23	1.5	2
19	20	200	3.9	1.0153	0.039	1.22	2	1.2
20	20	200	4	1.0157	0.0406	1.25	2.5	2

Table 1.Experimental results for ethanol production

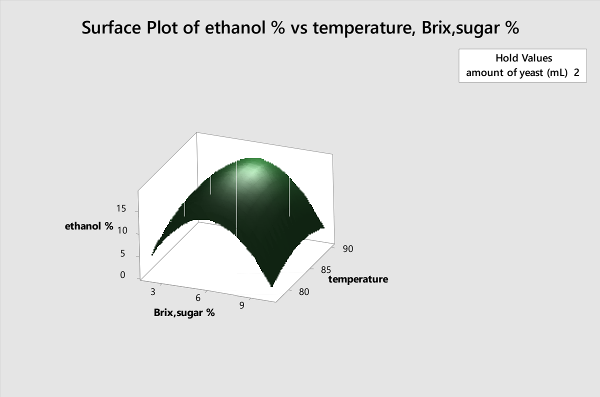

Figure 2.Surface Plot of ethanol% vs temperature,Sugar Brix%

5. CONCLUSION

This production showed that relatively high concentrations of sugars can be obtained by hydrolysis of 10 g of waste office paper using 5 % sulfuric acid during 60 minutes. The reaction time did not exert any significant effect for either sugar brix.The fermentation of hydrolysate with different amount of yeast to produce the ethanol *Saccharomyces cerevisiae* is the microorganism for fermenting lignocelluloses hydrolysis. However, the cellulose of waste paper is somehow difficult to hydrolyze enzymatically because it is associated with hemicelluloses and lignin. Therefore dilute-acid hydrolysis is a fast and easy way to pretreat lignocellulosic materials. The cost of this production is lowest because of waste paper. The cost of sulfuric acid ,yeast and sodium hydroxide were low cost compared with ethanol price.

The results of production predicted that the office waste paper is the most beneficial as a raw material for bioethanol production.

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