NEW POTENTIAL OF BIOMATERIAL FROM KENAF FIBRE BIOMASS

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ABSTRACT

The potential of biomass (kenaf fiber) that can be hydrolyzed to produce lactic acid was investigated by using *Lactobacillus rhamnosus*. The experiment parameters that involved in the optimization of pre-treatment process are mass of fiber, time and temperature. From the optimization process, the maximum result was obtained at Run 9 with 21.63% of glucose conversion which equivalent to 8.65 g/L glucose. Next, the fermentation process was conducted by using shake flask. There are three different media compositions were used in this process. This fermentation process was conducted for 3 days (at 37 °C and 150 rpm). In this fermentation process, 1.623%, 1.752% and 1.646% of lactic acid was produced in Samples 1, 2 and 3 by using 100 mL of media and the sample that produced highest lactic acid was Sample 2.

INTRODUCTION

Lactic acid is a potential chemical that can be applied in various purposes such as it can be used in food, pharmaceutical, cosmetic etc. Naturally lactic acid is very expensive since it is produced from food sources such as corn, potato, etc. Thus in order to avoid competition with food sources and also reduce the price of lactic acid, this project focus on biomass or lignocellulosic material which is kenaf fiber. Kenaf fiber which is scientifically known as *Hisbicus canabinus* is a warm annual season fiber crop.

OBJECTIVES

There are three main objectives in this project which are:

- To select the best pre-treatment method for the maximum glucose production from kenaf fiber.
- To optimize the hydrolysis conditions for the maximum production of glucose.
- To produce lactic acid (LA) from hydrolyzed sugar.

METHODOLOGY

Figure 1: Flow chart of lactic acid production

RESULTS & DISCUSSION

Table 1: Results for screening

Solvent	Replicate 1 (g/L)	Replicate 2 (g/L)	Average (g/L)	Percentage of Conversion (%)
H_2SO_4	3.0	2.9	2.95	9.83
NH_4OH	0.2	0.2	0.2	0.67
NaOH	1.1	1.1	1.1	3.67

$$\text{Percent Conversion (\%)} = \frac{\text{Average of glucose concentration}\left(\frac{g}{L}\right)}{\text{Weight of treated kenaf fiber}\left(\frac{g}{L}\right)} \times 100\%$$

Table 2: Actual and predicted value

Run	% of Conversion	
	Actual	Predicted
1	9.50	7.944861
2	2.50	2.061176
3	5.25	5.382134
4	10.00	11.02957
5	7.75	8.159556
6	6.00	5.847911
7	4.38	4.301594
8	7.00	9.413811
9	21.63	21.36739
10	7.50	8.731564
11	11.17	11.67302
12	12.25	11.99518
13	20.00	19.35036
14	2.25	1.323134
15	1.83	3.568701
16	9.50	7.944861
17	9.17	7.944861

Table 3: ANOVA for CCD model

Source	Sum of Squares	Degree of freedom	Mean Square	F Value	p-value (Prob > F)
Model	467.2733	9	51.9193	18.337	0.0005
A	13.20201	1	13.2020	4.663	0.0677
B	166.8723	1	166.872	58.936	0.0001
C	31.50625	1	31.5063	11.127	0.0125
AB	3.795013	1	3.7950	1.340	0.2849
AC	17.25781	1	17.2578	6.095	0.0429
BC	223.1328	1	223.133	78.806	<0.0001
A^2	10.039	1	10.039	3.5456	0.1017
B^2	0.264661	1	0.2647	0.0935	0.7687
C^2	0.264661	1	0.26466	0.0935	0.7687
Residual	19.81988	7	2.8314		
Lack of Fit	19.74728	5	3.9495	108.80	0.0091
Pure Error	0.0726	2	0.0363		
Cor Total	487.0932	16			

R- squared: 0.9593; Adj R-squared: 0.9070

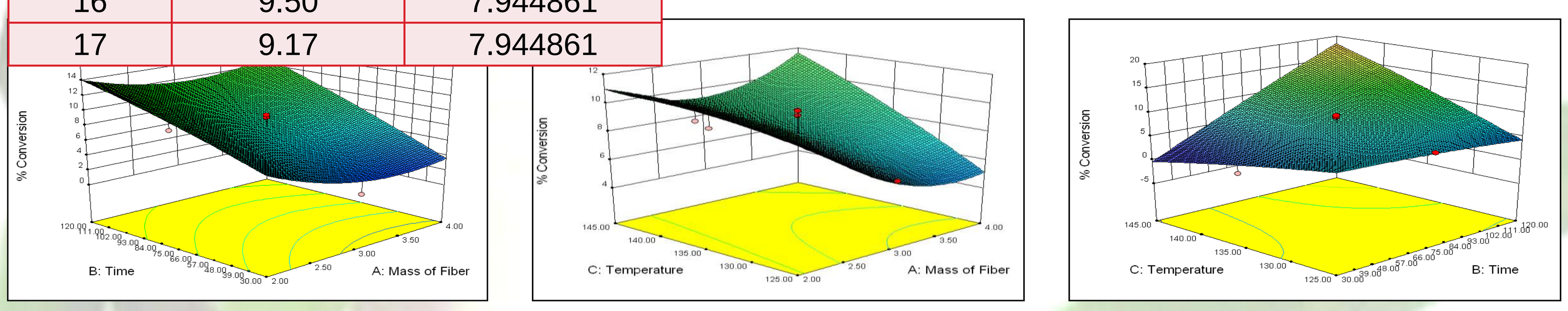

Figure 2: 3D plot

Table 3: Media component for fermentation

Sample No.	Glucose	Yeast Extract (g/L)	Peptone (g/L)
1	Hydrolyzed glucose (8.9 g/L)	2.5	-
2	Glucose(9.8 g/L)	0.8	2.0
3	Hydrolyzed glucose (8.9 g/L)	0.8	2.0

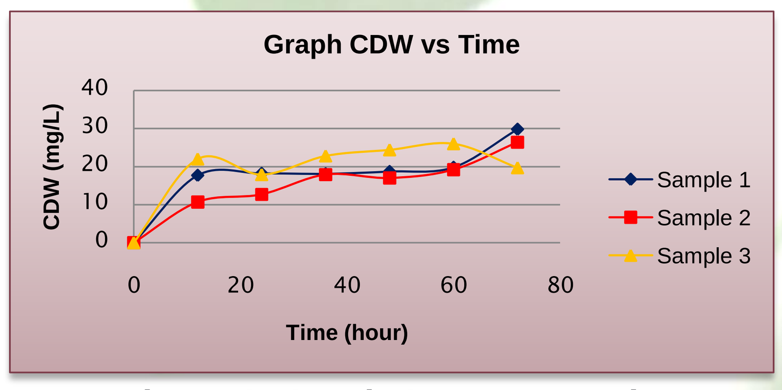

Figure 3: Graph CDW versus time

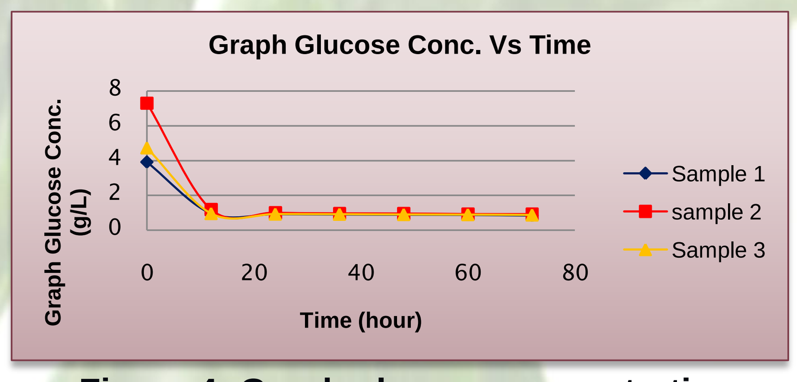

Figure 4: Graph glucose concentration versus time

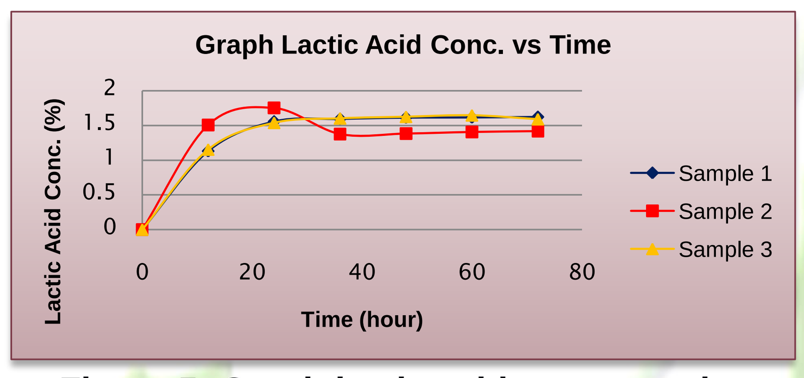

Figure 5: Graph lactic acid concentration versus time

CONCLUSION & RECOMMENDATION

Conclusions:

- This study found that the percentage of glucose conversion can be optimized through chemical pre-treatment of kenaf fiber in which H_2SO_4 gave the maximum percent conversion (21.63%).
- Fermentation of *L. rhamnosus* in shake flask was successfully produced lactic acid for all the Samples 1, 2 and 3 with 1.623%, 1.752% and 1.646%, respectively.
- From the results obtained, it can be concluded that the production of lactic acid is very low and needs to be improved.

Recommendations:

- The optimization of pre-treatment process needs to be repeated and improved.
- The fermentation process should be optimized by using bioreactor in order to control environmental conditions such as pO_2, pH, agitation and aeration.

- This project have been register for patent

ACKNOWLEDGEMENT

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KENAF

WHAT IS KENAF

- Kenaf fiber which is scientifically known as *Hisbicus canabinus* is a warm annual season fiber crop.
- A short day, annual, herbaceous plant processing high quality cellulose
- Kenaf grows quickly, rising to heights of 12-14 feet in as little as 4 to 5 months.
- Kenaf is mostly cultivated for its fiber in India, Vietnam, Indonesia, Malaysia, United State of America, South Africa, Thailand and to a small extent in southeast Europe

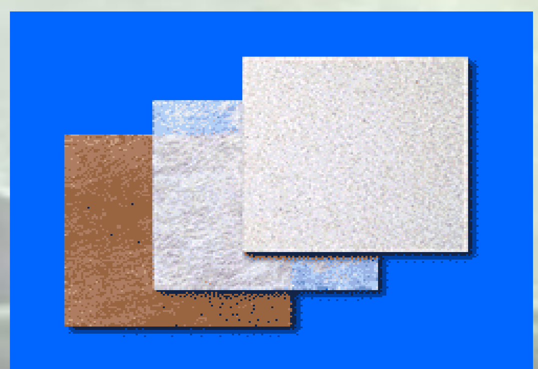
HISTORY OF KENAF

- Kenaf has been used as a cordage crop to produce twine, rope, and sackcloth for over six millennia
- Kenaf was first domesticated and used in northern Africa.
- India has produced and used kenaf for the last 200 years, while Russia started producing kenaf in 1902 and introduced the crop to China in 1935.

KENAF PRODUCTION

APPLICATION OF KENAF

1.0 PULP, PAPER AND CARDBOARD


2.0 PHARMACEUTICAL PRODDUCT


3.0 BIOFUEL

Bio Diesel
Bio Ethanol

4.0 TRADITIONAL CORDAGE USES


5.0 COMPOSITE AND ELECTRONIC

5.1 AUTOMOTIVE (CAR PARTS, ROOF, FRAME, BODY AND FLOOR)

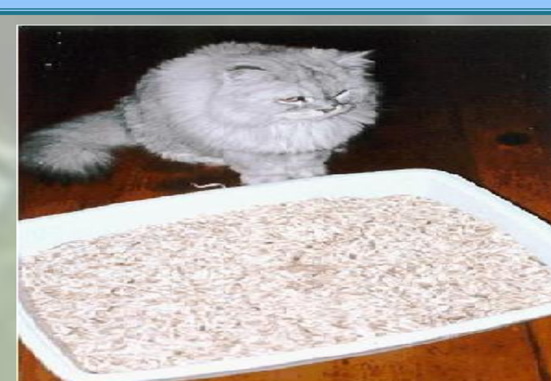


5.2 MOBILE PHONE


5.3 AEROPLANE



6.0 ANIMAL FEED

7.0 FOOD PACKAGING



8.0 ORGANIC ACID

Lactic Acid
Acetic Acid