5. sudiyani2017.pdf

.

Optimization pretreatment condition of sweet sorghum bagasse for production of second generation bioethanol

Yanni Sudiyani, Joko Waluyo, Eka Triwahyuni, Dian Burhani, Muryanto, Prasetyo Primandaru, Andika Putra Riandy, and Novia Sumardi

Citation: AIP Conference Proceedings **1803**, 020015 (2017); doi: 10.1063/1.4973142
View online: http://dx.doi.org/10.1063/1.4973142
View Table of Contents: http://aip.scitation.org/toc/apc/1803/1
Published by the American Institute of Physics

Optimization Pretreatment Condition of Sweet Sorghum Bagasse for Production of Second Generation Bioethanol

Yanni Sudiyani[1,a)], Joko Waluyo[1)], Eka Triwahyuni[1)], Dian Burhani[1)], Muryanto[1)], Prasetyo Primandaru[2)], Andika Putra Riandy[2)], Novia Sumardi[2)]

[1]*Research Center for Chemistry, Indonesian Institute of Sciences* (LIPI), *Kawasan PUSPIPTEK Serpong, Tangerang Selatan, Indonesia*

[2]*Chemical Engineering Department, Sriwijaya University, Palembang*

[a)]Corresponding author: sudiyani@gmail.com

Abstract. The bagasse residue of Sweet sorghum (*Sorghum bicolor* (L.) Moench) consist of cellulose 39.48%; hemicellulose 16.56% and lignin 24.77% that can be converted to ethanol. Pretreatment is of great importance to ethanol yield. In this study, pretreatment process was conducted in a 5-liter reactor using NaOH 10% at various temperature 110, 130, 150°C and reaction time 10, 20, 30 minutes and optimizing severity parameter (log R_0 between 1.3 - 2.9). The statistical analysis using two way anova showed that third variations of temperature give different effects significant on lignin, hemicellulose and cellulose content at 95% the confidence level. The optimum pretreatment of bagasse sorghum were obtained with Log R_0 value between 2.4-2.9. High severity value in pretreatment condition reduce lignin almost 84-86%, maximum reducing lignin content was 86% obtained at temperature 150°C for 20 minutes reaction time and cellulose increased almost two times the initial content.

INTRODUCTION

Today bioethanol has become one of prospective biofuels in the transportation sector. Most of bioethanol produced in Indonesia currently is from molasses, or starchy raw materials, such as cassava and corn, known first generation bioethanol (G1). These materials are important raw materials for producing food and supporting food industries, so will not be sufficient to meet the increasing demand for the fuel ethanol [1]. On the other side, there are large amount of abundantly lignocellulosic biomass wastes of agricultural, estate crops and forestry industries that has not been used, can be converted to ethanol, called as second generation bioethanol (G2), is a possible candidate for a cheap and renewable source of energy.

The bagasse residue after extracting the juice from the sweet sorghum stalk is lignocellulosic material that consist of cellulose hemicellulose and lignin, these material can be hydrolyzed into sugar and further fermented to ethanol [2]. On the conversion of lignocellulosic to ethanol, need three key steps i.e. pretreatment to modify the lignocellulose structure, enzymatic hydrolysis to obtain sugars and fermentation process. Pretreatment of lignocellulose has received considerable research globally due to its influence on the technical, economic and environmental sustainability of cellulosic ethanol production. For developing countries, alkali-based methods are relatively easy to deploy in decentralized, low-tech systems owing to advantages such as the requirement of simple reactors and the easy of operation.

International Symposium on Applied Chemistry (ISAC) 2016
AIP Conf. Proc. 1803, 020015-1–020015-7; doi: 10.1063/1.4973142
Published by AIP Publishing. 978-0-7354-1471-6/$30.00

Alkaline pretreatment is the target to reduce lignin content to increase enzyme access to holocellulose [3,4], reduction of cellulose crystallinity [5,6], and increase in the surface area [7,8] and porosity [9,10] of pretreated substrates, resulting in increased hydrolysis rate. The mechanism of alkaline pretreatment is saponification of intermolecular ester bonds crosslinking xylan, hemicelluloses and other component [11,12].

To fully utilize bagasse residue of sweet sorghum as a feedstock for ethanol production, optimal pretreatment is required to render the cellulose fiber more amenable to the action of hydrolize enzyme. The main goal of this work is to study the effect pretreatment of alkaline NaOH 10% concentration, reaction time and temperature on the sweet sorghum bagasse as raw material for ethanol production, function of pretreatment time and temperature was investigated to optimize the operating parameter of pretreatment, while glucose production is the parameter for evaluating allow enzymatic performance.

MATERIALS AND METHODS

Materials

Bagasse of Sweet Sorghum (*Sorghum bicolor* (L.) Moench) called (BS) was obtained from PT. Panen Energy, Malang East Java, Indonesia. After air-dried, physical pretreatment i.e. chipping and milling until 3 mm was conducted to maximize contact area of the substrate.

Alkaline Pretreatment

In this work optimization process of pretreatment was conducted using bench scale reactor a 5-liter at the Research Centre for Chemistry, Indonesian Institute of Sciences (LIPI). 250 g of BS (10% moisture content) was heated using NaOH 10% (kg/L) at 110,130 and 150°C for 10, 20 and 30 minutes. A solid liquid ratio was 1:5. The pressure was controlled four bars at early heating. After pretreatment, the material was pressed in order to separate solidity from liquid fraction. Solidity of BS treated was washed until wash water turned to pH 7 and dried in the oven at 50-60°C overnight. The composition of materials component before and after pretreatment was analyzed according to National Renewable Energy Laboratory (NREL) standard procedures [13].

The treatment severity was quantified by a semi-empirical parameter called severity parameter, log R_0, combining pretreatment time and temperature acording to the equation Overend, 1987, [14].

$$R_0 = t.e^{\left[\frac{T-100}{14.75}\right]} \quad (1)$$

where t is the time in minute and T the temperature in degree Celcius.

TABLE 2. Pretreated Samples Results

Pretreatment		After Treatment Charged Dry Matter (g)	Weight Loss (g)	Yield %	Recovered Biomass (%)
Temperature (^{o}C)	Time (min)				
110	10	150.27	99.73	39.89	60.11
110	20	149.28	100.72	40.29	59.71
110	30	103.51	146.49	58.60	41.40
130	10	134.28	115.72	46.29	53.71
130	20	149.34	100.66	40.26	59.74
130	30	139.17	110.83	44.33	55.67
150	10	154.43	95.57	38.23	63.44
150	20	158.59	128.60	51.44	65.56
150	30	163.89	86.11	34.44	63.44

After pretreatment, showed that some pretreatment results in terms of pretreatment efficiency is expressed as recovered biomass in percentage compared to initial biomass charged into the reactor. Dilute NaOH application loosens the biomass structure, separate the bonds between the lignin and the carbohydrates, increases the internal surface, decreases the degree of polymerization and crystallinity, and disrupts the lignin structure, that caused weight loss [15,16]. Highest recovered biomass was observed at temperature 150^{o}C.

Composition components of Pretreated substrates

Before pretreatment the carbohydrate fraction of BS (cellulose and hemicellulose) were 56.04% of total biomass, and the major component were cellulose (39.48%). Meanwhile, lignin content of BS was 24.77%, comparable to the lignin content of empty of fruit bunch (25.83%) [17]. Lignocellulosic biomass requires pretreatment, mainly because the lignin in plant cell walls forms a barrier against enzyme attack. An ideal pretreatment reduces the lignin content and crystallinity of the cellulose and increase surface area [18]. The loss of lignin in the pretreatment is one of the most important indicators of pretreatment effectiveness because the presence of lignin impedes enzymatic hydrolysis of the carbohydrates [15]. In order to degrade and reduce the lignin and non-cellulose component, BS was treated using alkaline solution NaOH 10%, nine samples were selected for the folowing stage, in the range Log R_0 1.3-2.9. The effect of NaOH 10% at different temperature and different times pretreatment. After treatment at all condition, the BS was quantified for lignocellulose components, the results as shown in Tabel 3.

Pretreatment changed the BS composition. From Table 3 it can be seen during pretreatment delignification was occured and the process was effective for reduction of hemicellulose, so the proportion of lignin decreased, and the cellulose content after pretreatment was increased in all pretreatment condition. The results shows the optimum pretreatment condition was NaOH 10% at 150^{o}C for 10-30 minutes, with the optimum loss of lignin and hemicellulose was 86%, and 55% respectively. Further increasing reaction time also affected in increase of cellulose content from 10 to 20 minutes and there was no significant effect reaction time after 20 minutes. The optimum cellulose content was 86.85% was achived at 150^{o}C for 20 minutes. Comparing the two parameter, we observe an approximately constant trend which does influence of recovered biomass in line with cellulose content after treatment. The increase of cellulose content and the decrease of hemicellulose and lignin content can facilitate the process of enzymatic hydrolysis.

TABLE 3. Chemical Composition of Bagasse Sweet Sorghum

Pretreatment Temperature (°C), Time (min)	Cellulose %	Hemicellulose %	Lignin %	Ash %
Untreated	39.48	16.56	24.77	4.20
110, 10	76.52	10.03	8.61	0.16
110, 20	78.06	9.94	8.31	0.32
110, 30	84.03	9.93	8.08	0.28
130, 10	81.74	8.87	6.16	0.25
130, 20	83.32	9.37	6.11	0.37
130, 30	88.25	8.57	5.45	0.55
150, 10	86.72	7.37	3.76	0.25
150, 20	86.85	7.45	3.51	0.52
150, 30	86.44	7.50	3.49	0.53

Further investigation for pretreatment parameters were carried out, using the analysis of two way ANOVA, to identify which parameter significantly affect the component cellulose, hemicellulose and lignin.

TABLE 4. ANOVA

Source	DF	Lignin				Hemicellulose				Cellulose			
		SS	MS	F	Sig	SS	MS	F	Sig	SS	MS	F	Sig
Corrected Model	8	68.16	8.52	2479	0.00	21.43	2.68	419.25	0.00	268.83	33.60	100.89	0.00
Intercept	1	636.40	636.40	185200	0.00	1380.17	1380.17	216000	0.00	125646.25	125646.25	377200	0.00
Temperature	2	67.19	33.59	9774	0.00	20.74	10.37	1623	0.00	159.75	79.87	239.80	0.00
Time	2	0.73	0.36	105.51	0.00	0.20	0.10	15.83	0.00	68.67	34.33	103.08	0.00
Tempera-ture*Time	4	0.25	0.06	18.33	0.00	0.49	0.12	18.97	0.00	40.42	10.11	30.34	0.00
Error	9	0.03	0.00			0.06	0.01			3.00	0.33		
Total	18	704.60				1401.66				125918.08			
Corrected Total	17	68.19				21.49							
R Squared (Adjst. R Squared)		1.00 (0.999)				0.997 (0.995)				0.989 (0.979)			

Considering parameter condition, optimal pretreatment seem to move towards higher Log R_0 2.4. In these study best results in terms of raw material (cellulose content 39,48%) was obtained at temperatur 150°C. These results in line with the statistical analysis using two way anova showed that third variations of temperature give different effects significant on lignin, hemicellulose and cellulose content at 95% the confidence level.

Considering the overall proccess, optimum pretreatment of bagasse sorghum were obtained with Log R_0 value between 2.4-2.9. High severity value in pretreatment condition resulted high in reduce lignin almost 84-86%, maximum reducing lignin content was 86% obtained at temperatur 150°C for 20 minutes reaction time and cellulose increased almost two times the initial content.

Enzymatic hydrolysis of treated substrate

Enzymatic hydrolysis is a step after pretreatment for bioethanol production. The BS substrate treated by NaOH 10% at 150°C was subjected to enzymatic saccharification. This condition was selected based on the highest component of celullose of BS treated for 10, 20 and 30 minutes was 86.44-86.85% and the lowest component of lignin at 3.49-3.76%. The BS substrate was treated with commercial cellulase preparation at enzyme loading 30 FPU/g substrate. The result can be seen in Figure 1.

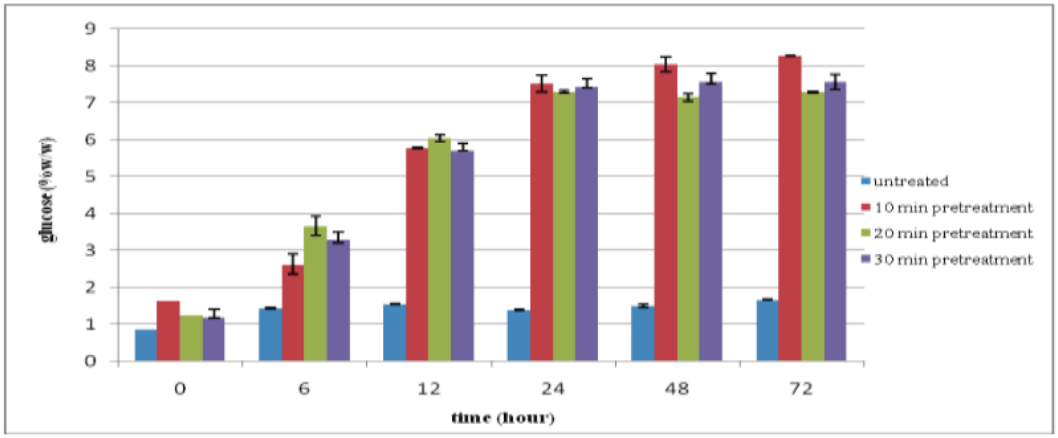

FIGURE 1. Glucose concentration from enzymatic hydrolysis of pretreated subtrates with alkaline pretreatment at 150°C and reaction time 10, 20 and 30 minutes

Figure 1 showed that glucose concentration from each substrates increased for 72 h of enzymatic hydrolysis. The treated substrates produced higher glucose concentration than untreated substrate. It is because of reduction of lignin content, reduction of cellulose crystallinity and increasing porosity of treated substrates. The highest concentration of glucose concentration can be obtained by pretreatment substrate at 150oC, 10 minutes. The optimum time for enzymatic hydrolysis was 48 h that produce glucose almost similar with 72 h, i.e. above 8% w/w. From the data can be conclude that alkaline pretreatment at 150oC, 10 minutes has been enough to produce high glucose concentration.

CONCLUSIONS

Considering the overall proccess, optimum pretreatment of bagasse sorghum were obtained at Log R0 value between 2.4-2.9. Based on the results, pretreatment at 150oC gives the highest of cellulose content and the lowest of lignin content. The pretreatment condition of bagasse sorghum at 150oC for 10 minutes produces the optimal glucose concentration for bioethanol production.

ACKNOWLEDGEMENTS

The authors are in deeply indebted to Hendris Hendarsyah Kurniawan, and Novita Ariani for their technical support and cooperation.

REFERENCES

1. Lijun Wang, Zhenglin Luo, Abolghasem Shahbazi. Optimization of simultaneous saccharification and fermentation for the production of ethanol from sweet sorghum (Sorghum bicolor) bagasse using respon surface methodology. Industrial Crops and Products. 2013; 42: 280-291.
2. Shen,F., Saddler, J.N.,Liu,R.,Lin,L., Deng,S., Zhang,Y., Yang,G., Xiao,H., Li,Y. Evaluation of Steam pretreatment on sweet sorghum bagasse for enzymatic hydrolysis and bioethanol production. Carbohydrate Polymers. 2011; 86: 1542-1548.
3. J. S. Lim, Z. Abdul Manan, S. R. Wan Alwi, and H. Hashim. A review on utilisation of biomass from rice industry as a source of renewable energy," Renewable and Sustainable Energy Reviews. 2012; 16, (5): 3084–3094.
4. Y. Z. Pang, Y. P. Liu, X. J. Li, K. S. Wang, and Yuan, H. R. Improving biodegradability and biogas production of corn stover through sodium hydroxide solid state pretreatment. Energy and Fuels, 2008; 22 (4): 2761–2766.
5. J. Gabhane, S. P. M. Prince William, A. N. Vaidya, K. Mahapatra, and T. Chakrabarti. Influence of heating source on the efficacy of lignocellulosic pretreatment—a cellulosic ethanol perspective. Biomass and Bioenergy. 2011; 35(1) : 96–102.
6. Y. Kim, R. Hendrickson, N. S. Mosier et al., "Enzyme hydrolysis and ethanol fermentation of liquid hot water and AFEX pretreated distillers' grains at high-solids loadings," Bioresource Technology, 2008; 99 (12) :5206–5215.
7. J.-S. Lee, B. Parameswaran, J.-P. Lee, and S.-C. Park, "Recent developments of key technologies on cellulosic ethanol production," Journal of Scientific and Industrial Research, vol. 67, no. 11, pp. 865–873, 2008.
8. Y. Li, R. Ruan, P. L. Chen et al., "Enzymatic hydrolysis of corn stover pretreated by combined dilute alkaline treatment and homogenization," Transactions of the American Society of Agricultural Engineers. 2004; 47(3); 821–825.
9. P. Harmsen, W. Huijgen, L. Bermudez, and R. Bakker. Literature review of physical and chemical pretreatment processes for lignocellulosic biomass," Tech. Rep. 1184, Biosynergy, Wageningen UR Food & Biobased Research, 2010.
10. J.-W. Lee and T. W. Jeffries, "Efficiencies of acid catalysts in the hydrolysis of lignocellulosic biomass over a range of combined severity factors," Bioresource Technology. 2011;102(10): 5884–5890, 2011.
11. Zhu, S., Wu, Y., Yu, Z., Chen, Q., Wu, G., Yu, F., Wang, C. and Jin, S. Microwave-assisted alkali pretreatment of wheat straw and its enzymatic hydrolysis. *Process Biochemistry*. 2006; 94 (3):437-442.
12. Zhao, Y., Wang, Y., Zhu, J.Y., Ragauskas, A. and Dengl, Y. Enhanced enzymatic hydrolysis of Spruce by Alkaline Pretreatment at Low Temperature. *Biotechnology and Bioengineering*, 2008; 99 (6).
13. Overend, R.p. et al. Fractionation of lignocellulosic by steam –aaqueous pre-treatment., Phil.Trans.R.Soc.Lond.A; 1987: 523-536.
14. Sluiter, B., Hames, R., Ruiz, C., Scarlata, J., Sluiter, D., Templeton, M., and Crocker, D. Determination of structural carbohydrates and lignin in biomass. *Technical report NREL/TP-510-Int. J. Environ. Bioener.* 2012, 3(2): 88-97Copyright.
15. Mosier N., Wyman,C., Dale B., et al., Features of promising technologies for pretreatment of lignocellulosic biomass. Bioresource Technology. 2005;96 (6): 673–686.
16. Rocha GJMR, Nascimentoa VM, Silva FMN, Corso DLS,Goncalves AR. Contributing to the environmental sustainability of the secondgeneration ethanol production:Delignification of sugarcane bagassewith sodium hydroxide recycling. *Industrial Crops and Products*. 2014: **59**: 63–68.
17. Sudiyani, Y., Kiky C. Sembiring., hendarsyah H., Alawiyah, S. Alkaline pretreatment and enzymatic saccharification of oil palm empty fruit bunch fiber for ethanol production. Indonesian J. of Biotechnology Reaserach on Estate Crops. 2010 (78) 2 : 74-78.
18. Silverstein, R. A. Chen, Y., Sharma-Shivappa, R. R., Boyette, M. D. and J. Osborne, "A comparison of chemical pretreatment methods for improving saccharification of cotton stalks," Bioresource Technology. 2007;98(16): 3000–3011.

5. sudiyani2017.pdf

ORIGINALITY REPORT

35%
SIMILARITY INDEX

PRIMARY SOURCES

1	Dahnum, Deliana, Sri Octavia Tasum, Eka Triwahyuni, Muhammad Nurdin, and Haznan Abimanyu. "Comparison of SHF and SSF Processes Using Enzyme and Dry Yeast for Optimization of Bioethanol Production from Empty Fruit Bunch", Energy Procedia, 2015. Crossref	177 words — 7%
2	downloads.hindawi.com Internet	111 words — 4%
3	mp.iribb.org Internet	93 words — 4%
4	Deliana Dahnum, Vera Barlianti, Kiky C. Sembiring, Anis Kristiani, Muryanto Muryanto, Yanni Sudiyani. "Effect of Combining Electron Beam Irradiation and Alkaline Pretreatments of OPEFB for Enzymatic Hydrolysis and Fermentation of Ethanol", Jurnal Kimia Terapan Indonesia, 2017 Crossref	75 words — 3%
5	Wang, Lijun, Zhenglin Luo, and Abolghasem Shahbazi. "Optimization of simultaneous saccharification and fermentation for the production of ethanol from sweet sorghum (Sorghum bicolor) bagasse using response surface methodology", Industrial Crops and Products, 2013. Crossref	58 words — 2%

6 Lu Bianfang, Zhang Suping, Wang Gang, Chen Yuancheng, Ren Zhengwei, Xu Qingli, Yan Yongjie. "Acid pretreatment of bagasse pith at low temperature with steam-assisted heating", Journal of Renewable and Sustainable Energy, 2013
Crossref
48 words — 2%

7 Sri Sugiwati, Suaidah Suaidah, Eka Triwahyuni, Muryanto Muryanto, Yosie Andriani, Haznan Abimanyu. " Hydrolysis of Cellulose from Oil Palm Empty Fruit Bunch using ", E3S Web of Conferences, 2021
Crossref
41 words — 2%

8 Franco Cotana, Gianluca Cavalaglio, Mattia Gelosia, Andrea Nicolini, Valentina Coccia, Alessandro Petrozzi. "Production of Bioethanol in a Second Generation Prototype from Pine Wood Chips", Energy Procedia, 2014
Crossref
39 words — 1%

9 S. Hari Krishna, K. Prasanthi, G.V. Chowdary, C. Ayyanna. "Simultaneous saccharification and fermentation of pretreated sugar cane leaves to ethanol", Process Biochemistry, 1998
Crossref
34 words — 1%

10 M. Ettoumi, M. Jouini, C.M. Neculita, S. Bouhlel, L. Coudert, I. Haouech, M. Benzaazoua. "Characterization of Kef Shfeir phosphate sludge (Gafsa, Tunisia) and optimization of its dewatering", Journal of Environmental Management, 2020
Crossref
31 words — 1%

11 file.scirp.org
Internet
27 words — 1%

12 Jianliang Yu, Jing Zhong, Xu Zhang, Tianwei Tan. "Ethanol Production from H2SO3-Steam-Pretreated
22 words — 1%

Fresh Sweet Sorghum Stem by Simultaneous Saccharification and Fermentation", Applied Biochemistry and Biotechnology, 2008
Crossref

---

13 eprints.undip.ac.id — 18 words — 1%
Internet

---

14 Muryanto, Eka Triwahyuni, Haznan Abimayu, Agung Cahyono, Effendi Tri Cahyono, Yanni Sudiyani. "Alkaline Delignification of Oil Palm Empty Fruit Bunch Using Black Liquor from Pretreatment", Procedia Chemistry, 2015 — 16 words — 1%
Crossref

---

15 Ajeng Arum Sari, Feni Amriani, Rifahny Intan Satria Akhmad, Muhammad Rylo Pambudi, Rievan Putra Pamungkas, Muryanto Muryanto. "Adsorption of acid red and acid orange with adsorbent from bioethanol black liquor sludge", AIP Publishing, 2018 — 15 words — 1%
Crossref

---

16 Ting-Ting Jiang, Yan Liang, Xiang Zhou, Zi-Wei Shi, Zhi-Jun Xin. "Optimization of a pretreatment and hydrolysis process for the efficient recovery of recycled sugars and unknown compounds from agricultural sweet sorghum bagasse stem pith solid waste", PeerJ, 2019 — 15 words — 1%
Crossref

---

17 W.-L. Sun, W.-Y. Tao. "Simultaneous Saccharification and Fermentation of Rice Straw Pretreated by a Sequence of Dilute Acid and Dilute Alkali at High Dry Matter Content", Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 2013 — 15 words — 1%
Crossref

---

18 Isabella De Bari, Federico Liuzzi, Antonio Villone, Giacobbe Braccio. "Hydrolysis of concentrated — 13 words — < 1%

suspensions of steam pretreated Arundo donax", Applied Energy, 2013
Crossref

---

19 Yanni Sudiyani, Eka Tri Wahyuni, Muryanto Muryanto, Sephtian Marno, Nelizza Putri. "Bioethanol Production from Alkali Steam Explosion of Oil Palm of Empty Fruit Bunch Fiber", IOP Conference Series: Materials Science and Engineering, 2020
Crossref

13 words — < 1%

---

20 Arif Rahman, Nining Betawati Prihantini, Nasruddin. "Fatty acid of microalgae as a potential feedstock for biodiesel production in Indonesia", AIP Publishing, 2019
Crossref

12 words — < 1%

---

21 Jamal, MS, SMA Sujan, MY Miah, SK Banik, SU Ahmed, and B Feroza. "Ball Milling Pretreatment of Bagasse for Ethanol Production by Enzymatic Saccharification and Fermentation", Bangladesh Journal of Scientific and Industrial Research, 2011.
Crossref

12 words — < 1%

---

22 Matsakas, Leonidas, and Paul Christakopoulos. "Fermentation of liquefacted hydrothermally pretreated sweet sorghum bagasse to ethanol at high-solids content", Bioresource Technology, 2013.
Crossref

9 words — < 1%

---

23 Jiby Kudakasseril Kurian, Yvan Gariepy, Valerie Orsat, G. S. Vijaya Raghavan. "Comparison of steam-assisted versus microwave-assisted treatments for the fractionation of sweet sorghum bagasse", Bioresources and Bioprocessing, 2015
Crossref

8 words — < 1%

24 Zehui Jiang, Benhua Fei, Zhiqiang Li. "Pretreatment of bamboo by ultra-high pressure explosion with a high-pressure homogenizer for enzymatic hydrolysis and ethanol fermentation", Bioresource Technology, 2016
Crossref
8 words — < 1%

25 scholarbank.nus.edu.sg
Internet
8 words — < 1%

26 Teuku Beuna Bardant, Deliana Dahnum, Nur Amaliyah. "Simultaneous or separated; comparison approach for saccharification and fermentation process in producing bio-ethanol from EFB", AIP Publishing, 2017
Crossref
6 words — < 1%

27 discovery.ucl.ac.uk
Internet
6 words — < 1%

EXCLUDE QUOTES	OFF	EXCLUDE SOURCES	OFF
EXCLUDE BIBLIOGRAPHY	ON	EXCLUDE MATCHES	OFF