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DAFTAR PUSTAKA

Aggarwal, N.K., Kumar, N., & Mittal, M.(2022). *Bioethanol Production: Past and Present*. Switzerland: Springer.

Alqahtani, A. M. (2024). Sweet sorghum and bagasse: a comprehensive review of feedstock traits, conversion processes, and economic viability for bioethanol and biogas production. *Biofuels*, *15*(5), 575–585. https://doi.org/10.1080/17597269.2023.2261789

Ambaye, T. G., Vaccari, M., Bonilla-Petriciolet, A., Prasad, S., van Hullebusch, E. D., & Rtimi, S. (2021). Emerging technologies for biofuel production: A critical review on recent progress, challenges and perspectives. *Journal of Environmental Management*, *290*, 1–15. https://doi.org/10.1016/j.jenvman.2021.112627

Amrillah, N. A. Z., Hanum, F. F. , dan, & Rahayu, A. (2022). Studi Efektivitas Metode Ekstraksi Selulosa dari Agricultural Waste. *Seminar Nasional Penelitian LPPM UMJ*. http://jurnal.umj.ac.id/index.php/semnaslit

Anita, S.H., Fitria, Solihat, N.N., Sari, F.P., Risanto, L., Fitriasari, W., & Hermiati, E. (2020). Optimization of Microwave-Assisted Oxalic Acid Pretreatment of Oil Palm Empty Fruit Bunch for Production of Fermentable Sugars. *Waste and Biomass Valorization*, 11, 2673-2687.

Anuradha, A., & Sampath, M. K. (2024). Process optimization for the *pretreatment* of rice husk with *Deep Eutectic Solvent* for efficient sugar production. *Environmental Technology (United Kingdom)*, *45*(19), 3807–3815. https://doi.org/10.1080/09593330.2023.2232934

Aydinsakir, K., Buyuktas, D., Dinç, N., Erdurmus, C., Bayram, E., & Yegin, A. B. (2021). Yield and bioethanol productivity of sorghum under surface and subsurface drip irrigation. *Agricultural Water Management*, *243*. https://doi.org/10.1016/j.agwat.2020.106452

Badan Pusat Statistik. (2019). *Statistik Tanaman Pangan Indonesia 2019-2020*. BPS.

Badiei, M., Asim, N., Jahim, J. M., & Sopian, K. (2014). Comparison of Chemical *Pretreatment* Methods for Cellulosic Biomass. *APCBEE Procedia*, *9*, 170–174. https://doi.org/10.1016/j.apcbee.2014.01.030.

Bahadur, I., Singh, P., Siddique, J.A., *et al*. (2025). *Deep Eutectic Solvent*. Amsterdam: Elsevier.

Bajpai, P.(2013). *Advances in Bioethanol*. Patiala: Springer

Cao, W., Sun, C., Liu, R., Yin, R., & Wu, X. (2012). Comparison of the effects of five *pretreatment* methods on enhancing the enzymatic digestibility and ethanol production from sweet sorghum bagasse. *Bioresource Technology*, *111*, 215–221. https://doi.org/10.1016/j.biortech.2012.02.034

Chasisa, I.N. (2017). Pengaruh Jenis Alkali Dan Lama Perendaman Pada Suhu Kamar Selama Proses *Pretreatment* Jerami Terhadap Kadar Lignoselulosa, Kadar Gula Reduksi, Dan Mikrostrukturnya. *Skripsi*. Universitas Lampung.

Chauhan, N. M., Hajare, S. T., Mamo, B., & Madebo, A. A. (2021). Bioethanol Production from Stalk Residues of Chiquere and Gebabe Varieties of Sweet

UNIVERSITAS GADJAH MADA
Optimasi Proses Pretreatment Ampas Batang Sorgum (Sorghum bicolor (L.) Moench) Dengan Menggunakan Deep Eutectic Solvent (DES) Untuk Produksi Selulosa
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Sorghum. *International Journal of Microbiology*, *2021*. https://doi.org/10.1155/2021/6696254

Chelladurai, S. J. S., Murugan, K., Ray, A. P., Upadhyaya, M., Narasimharaj, V., & Gnanasekaran, S. (2020). Optimization of process parameters using response surface methodology: A review. *Materials Today: Proceedings*, *37*(Part 2), 1301–1304. https://doi.org/10.1016/j.matpr.2020.06.466

Chio, C., Sain, M., & Qin, W. (2019). Lignin utilization: A review of lignin depolymerization from various aspects. In *Renewable and Sustainable Energy Reviews* (Vol. 107, pp. 232–249). Elsevier Ltd. https://doi.org/10.1016/j.rser.2019.03.008

Costa-Trigo, I., Paz, A., Morán-Aguilar, M. G., Pérez Guerra, N., Pinheiro de Souza Oliveira, R., & Domínguez, J. M. (2023). Enhancing the biorefinery of chestnut burrs. Part I. Study of the *pretreatment* with choline chloride urea diluted *Deep Eutectic Solvent*. *Biomass and Bioenergy*, *173*. https://doi.org/10.1016/j.biombioe.2023.106786

Darwin. (2020). *Bioenergi & Biofuel : Teori dan Terapan*. Banda Aceh: Syiah Kuala University Press.

Datta, A., Bettermann, A., & Kirk, T. K. (1991). Identification of a specific manganese peroxidase among ligninolytic enzymes secreted by *Phanerochaete chrysosporium* during wood decay. *Applied and Environmental Microbiology*, Vol.57(5), 1453–1460. https://doi.org/10.1128/aem.57.5.1453-1460.1991

Degam, G. (2017). *Deep Eutectic Solvents Synthesis, Characterization and Applications in Pretreatment of Lignocellulosic Biomass* [Electronic Theses and Dissertations, South Dakota State University]. https://openprairie.sdstate.edu/etd

Dien, B. S. (2010). *Mass balances and analytical methods for biomass pretreatment experiments. In A. A. Vertès, N. Qureshi, H. P. Blaschek, & H. Yukawa (Eds.), Biomass to biofuels: Strategies for global industries*. Wiley. https://doi.org/10.1002/9780470750025.ch11

El Achkar, T., Greige-Gerges, H., & Fourmentin, S. (2021). Basics and properties of *Deep Eutectic Solvent*s: a review. In *Environmental Chemistry Letters* (Vol. 19, Issue 4, pp. 3397–3408). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s10311-021-01225-8

Ellison, C., Elkasabi, Y., & Mullen, C. A. (2026). Coupled electromagnetic and thermal analysis of microwave-heated particle beds: Effect of solid volume fraction and particle size. *Thermal Science and Engineering Progress*, Vol. 69, 104463.

Ethaib, S. (2024). *Microwave*-assisted *pretreatment* for lignocellulosic biomass energy conversion path. In *Bioresource Technology Reports* (Vol. 28). Elsevier Ltd. https://doi.org/10.1016/j.biteb.2024.102006

Fathurrahmaniah. (2022). Potensi Sorgum (*Sorghum Bicolor* L. *Moench*) Sebagai Bahan Baku Pembuatan Bioetanol. *Jurnal PIPA: Pendidikan Ilmu Pengetahuan Alam*, *03*(02), 42–45.

UNIVERSITAS
GADJAH MADA
**Optimasi Proses Pretreatment Ampas Batang Sorgum (Sorghum bicolor (L.) Moench) Dengan Menggunakan
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Fourmentin, S., Gomes, M.C., and Lichtfouse, E. (2021). *Deep Eutectic Solvent for Medicine, Gas Solubilization and Extraction of Natural Substances*. Switzerland: Springer.

Gandam, P. K., Chinta, M. L., Pabbathi, N. P. P., Baadhe, R. R., Sharma, M., Thakur, V. K., Sharma, G. D., Ranjitha, J., & Gupta, V. K. (2022). Second-generation bioethanol production from corncob: A comprehensive review on pretreatment and bioconversion strategies, including techno-economic and lifecycle perspective. *Industrial Crops & Products*, Vol.186, 115245.

García-Negrón, V., Stoklosa, R. J., & Toht, M. J. (2024). Effects of NaOH and Na2CO3 *pretreatment* on the saccharification of sweet sorghum bagasse. *Frontiers in Chemical Engineering*, *6*. https://doi.org/10.3389/fceng.2024.1449114

Ghosh, S., Rana, M., & Park, J. H. (2024). Depolymerization of Kraft Lignin Using a Metal Chloride-Based *Deep Eutectic Solvent*: Pathways to Sustainable Lignin Valorization. *MDPI*, *14*. https://doi.org/10.3390/app142411571

Guo, Y., Zhang, J., Wang, C., Liu, M., You, J., Yin, L., & Shi, M. (2024). Green *pretreatment* of lignocellulosic biomasses via *Deep Eutectic Solvent*s. In *Sustainable Chemistry and Pharmacy* (Vol. 39). Elsevier B.V. https://doi.org/10.1016/j.scp.2024.101569

Hashemi, B., Sarker, S., Lamb, J. J., & Lien, K. M. (2021). Yield improvements in anaerobic digestion of lignocellulosic feedstocks. In *Journal of Cleaner Production* (Vol. 288). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2020.125447

Hassan, E. S. R. E., & Mutelet, F. (2022). Evaluation of miscanthus *pretreatment* effect by Choline chloride based *Deep Eutectic Solvent*s on bioethanol production. *Bioresource Technology*, *345*. https://doi.org/10.1016/j.biortech.2021.126460

Hermiati, E., Mangunwidjaja, D., Sunarti, T. C., Suparno, O., & Prasetya, D. B. (2010). Pemanfaatan Biomassa Lignoselulosa Ampas Tebu Untuk Produksi Bioetanol. *Jurnal Litbang Pertanian*, *29*(4), 2010.

Hikmah, N.N. (2017). Optimasi Ekstraksi Biji Kedelai (Glycine max (L.) Merr) Terhadap Kandungan Stigmasterol Menggunakan Response Surface Methodology. *Skripsi*. Fakultas Farmasi, Universitas Gadjah Mada.

Huang, Y.-F., Chiueh, P.-T., Kuan, W.-H., & Lo, S.-L. (2016). Microwave pyrolysis of lignocellulosic biomass: Heating performance and reaction kinetics. *Energy*, Vol. 100, 137–144.

Hu, L., Fang, X., Du, M., Luo, F., & Guo, S. (2020). Hemicellulose-Based Polymers Processing and Application. *American Journal of Plant Sciences*, *11*(12), 2066–2079. https://doi.org/10.4236/ajps.2020.1112146

Hu, Z., & Wen, Z. (2008). Enhancing enzymatic digestibility of switchgrass by *microwave*-assisted alkali *pretreatment*. *Biochemical Engineering Journal*, *38*(3), 369–378. https://doi.org/10.1016/j.bej.2007.08.001

Iriawan, N., & Astuti, S.P. (2006). *Mengolah Data Statistik dengan Mudah Menggunakan Minitab 14*. Yogyakarta: Penerbit ANDI.

Jafari, K., Hossein Fatemi, M., & Lugo, L. (2022). An experimental study of novel nanofluids based on *Deep Eutectic Solvent*s (DESs) by Choline chloride and

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

ethylene glycol. *Journal of Molecular Liquids*, *360*. https://doi.org/10.1016/j.molliq.2022.119521

Jain, A., & Bridges, W. C. (2016). Comparison of chemical treatment methods for loblolly pine to utilize as enzyme hydrolyzate feedstock. *Biomass and Bioenergy*, Vol.94, 130–145.

Jetti, K. D., & Kishore, N. S. (2024). Impact of Alkali *Pretreatment* Methods of Bagasse from Different Sweet Sorghum Varieties for Bioethanol Production. *Sugar Tech*, *26*(2), 562–572. https://doi.org/10.1007/s12355-024-01370-8

Kartini, A. M., & Pandebesie, E. S. (2016). Produksi bioetanol dari batang *Sorghum bicolor* (L.) *Moench* dengan *Saccharomyces cerevisiae* dan konsorsium *S. cerevisiae-Pichia stipitis*. *Jurnal Purifikasi*, Vol. 16(2), 118–129.

Kementerian Koordinator Bidang Perekonomian Republik Indonesia. (2022). *Dimulainya pilot project pengembangan sorgum menandai upaya substitusi dan diversifikasi dalam penguatan ketahanan pangan* [Siaran pers]. https://www.ekon.go.id/

Khruengsai, S., Promhom, N., Sriphaco, T., Siriwat, P., & Pripdeveech, P. (2023). Optimization of enzyme-assisted microwave extraction of Zanthoxylum limonella essential oil using response surface methodology. *Scientific Reports*, Vol. 13, 12872.

Koçar, G., & Civaş, N. (2013). An overview of biofuels from energy crops: Current status and future prospects. *Renewable and Sustainable Energy Reviews*, *28*, 900–916.

Kurniawan, E.W. (2018). *Biomassa Sumber Energi Terbarukan*. Ponoorgo : Wade Group Publishing.

Li, L., Yu, L., & Wu, Z. (2019). Delignification Of Poplar Wood With Lactic Acid-Based Deep Eutectic Solvents. *Wood Research*, *64*(3), 499-514.

Li, Y., Li, Y., Li, H., Fan, X., Yan, H., Cai, M., Xu, X., & Zhu, M. (2023). Insights into the tribological behavior of choline chloride—urea and choline chloride—thiourea *Deep Eutectic Solvent*s. *Friction*, *11*(1), 76–92. https://doi.org/10.1007/s40544-021-0575-4

Limahelu, F. A., Jasman, & Sarifudin, K. (2021). Optimasi Suhu, pH, dan Konsentrasi Inokolum pada Proses Ko-Fermentasi Batang Sorgum Manis (Sorghum bicolor (L.) Moench) dengan Biakan Saccharomyces cerevisiae-Trichoderma reesei. *Jurnal Beta Kimia*, *01*(2), 54–63. http://ejurnal.undana.ac.id/index.php/jbkHalaman|54

Longo Jr., L.S. and Craveiro, M.V. (2018). *Deep Eutectic Solvent*s as Unconventional Media for Multicomponent Reactions. *Journal of the Brazilian Chemical Society*, Vol. 0, No. 0 :1-27

López-Sandin, I., Rodríguez-Jasso, R. M., Gutiérrez-Soto, G., Rosero-Chasoy, G., Shiva, González-Gloria, K. D., & Ruiz, H. A. (2022). Energy Assessment of Second-Generation (2G) Bioethanol Production from Sweet Sorghum (Sorghum bicolor (L.) Moench) Bagasse. *Agronomy*, *12*(12). https://doi.org/10.3390/agronomy12123106

Mafa, M. S., Malgas, S., Bhattacharya, A., Rashamuse, K., & Pletschke, B. I. (2020). The effects of alkaline pretreatment on agricultural biomasses (corn

UNIVERSITAS
GADJAH MADA
**Optimasi Proses Pretreatment Ampas Batang Sorgum (Sorghum bicolor (L.) Moench) Dengan Menggunakan
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

cob and sweet sorghum bagasse) and their hydrolysis by a termite-derived enzyme cocktail. *Agronomy*, Vol. 10(8), 1211.

Manmai, N., Unpaprom, Y., Ponnusamy, V. K., & Ramaraj, R. (2020). Bioethanol production from the comparison between optimization of sorghum stalk and sugarcane leaf for sugar production by chemical *pretreatment* and enzymatic degradation. *Fuel*, *278*. https://doi.org/10.1016/j.fuel.2020.118262

Meindl, A., Petutschnigg, A., & Schnabel, T. (2022). *Microwave*-Assisted Lignin Extraction—Utilizing *Deep Eutectic Solvent*s to Their Full Potential. *Polymers*, *14*(20). https://doi.org/10.3390/polym14204319

Mubarak Alqahtani, A. (2024). Sweet sorghum and bagasse: a comprehensive review of feedstock traits, conversion processes, and economic viability for bioethanol and biogas production. *Biofuels*, *15*(5), 575–585. https://doi.org/10.1080/17597269.2023.2261789

Muley, P. D., Mobley, J. K., Tong, X., Novak, B., Stevens, J., Moldovan, D., Shi, J., & Boldor, D. (2019). Rapid *microwave*-assisted biomass delignification and lignin depolymerization in *Deep Eutectic Solvent*s. *Energy Conversion and Management*, *196*, 1080–1088. https://doi.org/10.1016/j.enconman.2019.06.070

Mulyadi, I. (2019). Isolasi Dan Karakterisasi Selulosa : Review. *Jurnal Saintika Unpam : Jurnal Sains Dan Matematika Unpam*, *1*(2), 177–182. https://doi.org/10.32493/jsmu.v1i2.2381

Myers, R. H., Montgomery, D. C., & Anderson-Cook, C. M. (2016). *Response surface methodology: Process and product optimization using designed experiments (4th ed.)*. New Jersey : John Wiley & Sons.

Nelson, N. (1944). A PHOTOMETRIC ADAPTATION OF THE SOMOGYI METHOD FOR THE DETERMINATION OF GLUCOSE. *Journal of Biological Chemistry*, 153(2), 375–380. https://doi.org/10.1016/S0021-9258(18)71980-7

Nor, N. A. M., Mustapha, W. A. W., & Hassan, O. (2016). *Deep Eutectic Solvent* (DES) as a *Pretreatment* for Oil Palm Empty Fruit Bunch (OPEFB) in Sugar Production. *Procedia Chemistry*, *18*, 147–154. https://doi.org/10.1016/j.proche.2016.01.023

Pabendon, M. B., Aqil, M., & Mas'ud, S. (2012). Kajian Sumber Bahan Bakar Nabati Berbasis Sorgum Manis. *Iptek Tanaman Pangan*, *7*, 123–129.

Pan, M., Zhao, G., Ding, C., Wu, B., Lian, Z., & Lian, H. (2017). Physicochemical transformation of rice straw after *pretreatment* with a *Deep Eutectic Solvent* of choline chloride/urea. *Carbohydrate Polymers*, *176*, 307–314. https://doi.org/10.1016/j.carbpol.2017.08.088

Perna, F. M., Vitale, P., & Capriati, V. (2020). *Deep Eutectic Solvent*s and their applications as green solvents. In *Current Opinion in Green and Sustainable Chemistry* (Vol. 21, pp. 27–33). Elsevier B.V. https://doi.org/10.1016/j.cogsc.2019.09.004

Punia, P., & Kumar, S. (2025). Study of bioethanol production from sorghum residue by optimization of pre-treatment and enzymatic degradation: Co-culturing of Saccharomyces cerevisiae and Pichia stipitis as fermentation approach. *Next Sustainability*, Vol. 5, 100131.

UNIVERSITAS
GADJAH MADA
**Optimasi Proses Pretreatment Ampas Batang Sorgum (Sorghum bicolor (L.) Moench) Dengan Menggunakan
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Rahmat, M. (2019). *Tanaman Penghasil Bahan Bakar*. Semarang: ALPRIN.

Rao, J., Lv, Z., Chen, G., & Peng, F. (2023). Hemicellulose: Structure, chemical modification, and application. In *Progress in Polymer Science* (Vol. 140). Elsevier Ltd. https://doi.org/10.1016/j.progpolymsci.2023.101675

Ravichandra, K., Balaji, R., Devarapalli, K., Batchu, U. R., Thadikamala, S., Banoth, L., Pinnamaneni, S. R., & Prakasham, R. S. (2023). Enzymatic production of prebiotic xylooligosaccharides from sorghum (Sorghum bicolor (L.) xylan: value addition to sorghum bagasse. *Biomass Conversion and Biorefinery*, *13*(12), 11131–11139. https://doi.org/10.1007/s13399-021-02216-z

Ren, H., Shi, R., Yang, D., Tian, H., Wang, L., Ling, Z., Li, J., Li, L., Sun, Y., & Zheng, Y. (2024). Innovative strategy to enhance bioconversion of sweet sorghum bagasse (SSB) by the combination of bio-fortified ensiling and dilute alkali *pretreatment*. *Industrial Crops and Products*, *211*. https://doi.org/10.1016/j.indcrop.2024.118208

Ruan, L., Wu, H., Wu, S., Zhou, L., Wu, S., & Shang, C. (2024). Optimizing the Conditions of *Pretreatment* and Enzymatic Hydrolysis of Sugarcane Bagasse for Bioethanol Production. *ACS Omega*, *9*(27), 29566–29575. https://doi.org/10.1021/acsomega.4c02485

Saini, J. K., Anurag, R. K., Arya, A., Kumbhar, B. K., & Tewari, L. (2013). Optimization of saccharification of sweet sorghum bagasse using response surface methodology. *Industrial Crops and Products*, *44*, 211–219. https://doi.org/10.1016/j.indcrop.2012.11.011

Sari, N.H. (2023). *Nanoselulosa Dari Tanaman Sembukan*. Sleman : Deepublish.

Setyawan, H.Y., Dewi, J.R., Ulandari, D., *et al*. (2023). *Energi Biomassa*. Malang : UB Press.

Sihono, Indriatama, W. M., Human, S., & Marina, Y. M. (2021). Perbaikan Komoditas Sorgum sebagai Pangan dan Bioenergi melalui Pemuliaan Mutasi Radiasi. *Seminar Nasional Dalam Rangka Dies Natalis Ke-45 UNS*, *5*(1), 345–354.

Sipos, B., Réczey, J., Somorai, Z., Kádár, Z., Dienes, D., & Réczey, K. (2009). Sweet sorghum as feedstock for ethanol production: Enzymatic hydrolysis of steam-pretreated bagasse. *Applied Biochemistry and Biotechnology*, *153*(1–3), 151–162. https://doi.org/10.1007/s12010-008-8423-9

Smith, E. L., Abbott, A. P., & Ryder, K. S. (2014). *Deep Eutectic Solvent*s (DESs) and Their Applications. In *Chemical Reviews* (Vol. 114, Issue 21, pp. 11060–11082). American Chemical Society. https://doi.org/10.1021/cr300162p

Sopandi, T. & Wardah. (2020). *Mikologi Dasar & Aplikasi*. Yogyakarta : Penerbit ANDI.

Sudiyani, Y., Aiman, S., & Mansur, D. (2019). *Perkembangan Bioetanol G2: Teknologi dan Perspektif*. Jakarta : LIPI Press.

Sun, X., Zhou, Z., Tian, D., Zhao, J., Zhang, J., Deng, P., Zou, H., & Lu, C. (2023). Acidic *Deep Eutectic Solvent* assisted mechanochemical delignification of lignocellulosic biomass at room temperature. *International Journal of Biological Macromolecules*, *234*. https://doi.org/10.1016/j.ijbiomac.2023.123593

UNIVERSITAS GADJAH MADA
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Sutini, Widihastuty, Y. R., & Ramadhani, A. N. (2019). Review: Hidrolisis Lignoselulosa dari Agricultural Waste Sebagai Optimasi Produksi Fermentable Sugar. *EQUILIBRUM*, *3*(2), 59–68. http://equilibrium.ft.uns.ac.id

Szpisják-Gulyás, N., Al-Tayawi, A.N., Horváth, Z.H., & László, Z. (2023). Methods for experimental design, central composite design and the Box–Behnken design, to optimise operational parameters: A review. *Acta Alimentaria 52*, 4, 521–537.

Tenhunen, T. M., Lewandowska, A. E., Orelma, H., Johansson, L. S., Virtanen, T., Harlin, A., Österberg, M., Eichhorn, S. J., & Tammelin, T. (2018). Understanding the interactions of cellulose fibres and *Deep Eutectic Solvent* of choline chloride and urea. *Cellulose*, *25*(1), 137–150. https://doi.org/10.1007/s10570-017-1587-0

Tomé, L. I. N., Baião, V., da Silva, W., & Brett, C. M. A. (2018). *Deep Eutectic Solvent*s for the production and application of new materials. In *Applied Materials Today* (Vol. 10, pp. 30–50). Elsevier Ltd. https://doi.org/10.1016/j.apmt.2017.11.005

Tse, T. J., Wiens, D. J., & Reaney, M. J. T. (2021). Production of bioethanol—a review of factors affecting ethanol yield. *Fermentation*, *7*(4). https://doi.org/10.3390/fermentation7040268

Varilla-Mazaba, A., Raggao-Sánchez, J. A., Calderón-Santoyo, M., Gómez-Rodríguez, J., & Aguilar-Uscanga, M. G. (2022). Optimization of lignin extraction by response surface methodology from sugarcane bagasse using deep eutectic solvents (DES). *Industrial Crops & Products*. 184. 115040

Wagle, D. V., Zhao, H., & Baker, G. A. (2014). *Deep Eutectic Solvent*s: Sustainable media for nanoscale and functional materials. *Accounts of Chemical Research*, *47*(8), 2299–2308. https://doi.org/10.1021/ar5000488

Wang, D., Hong, S., Chen, Z., Sun, Q., Xie, C., Wang, J., Wei, A., Shao, L., & Shen, X. (2025). Sustainable recycling of phenol-assisted *Deep Eutectic Solvent* for efficient lignocellulose fractionation and enzymatic hydrolysis. *Industrial Crops and Products*, *223*. https://doi.org/10.1016/j.indcrop.2024.120173

Widarsaputra, A., Prawatya, Y., & Sujana, I. (2022). Response Surface Methodology (RSM) Untuk Optimasi Pengolahan Keripik Nanas Menggunakan Mesin Vacuum Frying. *INTEGRATE: Industrial Engineering and Management System*, *6*(2), 70–77. https://jurnal.untan.ac.id/index.php/jtinUNTAN/issue/view/

Widyawati, N.L. (2014). *Pemanfaatan Microwave dalam Proses Pretreatment Degradasi Lignin Ampas Tebu (Bagasse) (pada produksi bioetanol)*. *(Thesis Sarjana*, Universitas Brawijaya). https://repository.ub.ac.id/id/eprint/149585

Wyantuti, S., Aristantia, R., Hartati, Y. W., & Bahti, H. H. (2020). Penerapan desain eksperimen Plackett-Burman dan Box-Behnken pada analisis voltametri pulsa diferensial untuk penentuan kadar senyawa kompleks Gd-DTPA. *ALCHEMY Jurnal Penelitian Kimia*, Vol. 16(1), 140–151.

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**Optimasi Proses Pretreatment Ampas Batang Sorgum (Sorghum bicolor (L.) Moench) Dengan Menggunakan
Deep Eutectic Solvent (DES) Untuk Produksi Selulosa**
Pengkuh Tameng Haryandi, Dr. Wagiman, S.T.P., M.Si. ; Dr. Darmawan Ari Nugroho, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Yang, B., Zhu, L., & He, Y. C. (2024). Valorization of rapeseed straw through alkali-assisting *Deep Eutectic Solvent* ChCl:Thiourea *pretreatment* at room temperature. *Fuel*, *378*. https://doi.org/10.1016/j.fuel.2024.132932

Yan, Z., Li, J., Chang, S., Cui, T., Jiang, Y., Yu, M., Zhang, L., Zhao, G., Qi, P., & Li, S. (2015). Lignin relocation contributed to the alkaline pretreatment efficiency of sweet sorghum bagasse. *Fuel*, *158*, 152–158.

Yetilmezsoy, K., Demirel, S., & Vanderbei, R. J. (2009). Response surface modeling of Pb(II) removal from aqueous solution by *Pistacia vera* L.: Box–Behnken experimental design. *Journal of Hazardous Materials*, *171*(1–3), 551–562. https://doi.org/10.1016/j.jhazmat.2009.06.035

Yulia Rahmi, H., Kusumastuti, Y., & Hidayat, M. (2024). Isolasi Selulosa dari Tandan Kosong Kelapa Sawit Menggunakan *Deep Eutectic Solvent* (DES) Berbasis Kolin Klorida dan Asam Laktat. *Prosiding Seminar Hasil Penelitian Dan Pengabdian Kepada Masyarakat*, *7*, 57–64.

Zhang, Q., Vigier, K.D.O., Royer, S., & Jérôme, F. (2012). "*Deep Eutectic Solvent*s: Syntheses, Properties And Applications". *Chemical Society Review*, 7108-7146.

Zhou, Y., Stuart-Williams, H., Farquhar, G.D., & Hocart, C.H. (2010). The use of natural abundance stable isotopic ratio to indicate the presence of oxygen-containing chemical linkages between cellulose and lignin in plant cell walls. *Phytochemistry*, 71, 982-993.

Zhu, S., Wu, Y., Yu, Z., Chen, Q., Wu, G., Yu, F., Wang, C., & Jin, S. (2006). *Microwave*-assisted Alkali Pre-treatment of Wheat Straw and its Enzymatic Hydrolysis. *Biosystems Engineering*, *94*(3), 437–442. https://doi.org/10.1016/j.biosystemseng.2006.04.002

Zhu, Z., Rezende, C. A., Simister, R., McQueen-Mason, S. J., Macquarrie, D. J., Polikarpov, I., & Gomez, L. D. (2016). Efficient sugar production from sugarcane bagasse by *microwave* assisted acid and alkali *pretreatment*. *Biomass and Bioenergy*, *93*, 269–278. https://doi.org/10.1016/j.biombioe.2016.06.017