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การผลิตสารเพิ่มมูลค่าสูงจากชีวมวลลิกโนเซลลูโลส
Valorization of Lignocellulosic Biomass to Value Added Products

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ศูนย์วิศวกรรมโรงกลั่นชีวภาพและกระบวนการอัตโนมัติ สาขาวิชาวิศวกรรมเคมีและกระบวนการ บัณฑิตวิทยาลัยวิศวกรรมศาสตร์นานาชาติสิรินธร ไทย-เยอรมัน มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ

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The rapid growth in the global population has increased our dependence on fossil fuels. The increasing population requires more energy for economic and societal development, so they use non-renewable resources. Owing to this, global fossil fuel consumption has been increasing for the past few decades to foster the needs of a growing population. Following this unsustainable model of development has caused the depletion of fossil fuels at an alarming rate. The impact of unsustainable development is not limited to fossil fuel depletion. It has also resulted in climate change, global warming, and pollution. United Nations (UN) have considered this a grave issue and has put forward "The Sustainable Development Goals (SDG) to reduce the impact of unsustainable growth on society [1]. The UN has also urged every country to follow SDG to ensure sustainability at the global level. Apart from this, the United Nations Climate Change Conference, COP 27 conducted in Egypt in 2022 has laid down goals related to the reduction in emissions by 40% in Thailand within 2030 and following the Bio Circular Green Economy model for sustainable growth, climate change, biodiversity conversion and waste management.

Considering this as a significant issue, researchers have identified lignocellulosic biomass as an alternative resource to produce biofuels, platform chemicals and other value-added products [2]. Moreover, it is widely available at a low cost to be used in a biorefinery to produce value-added products from it. Globally, around 140 billion metric tons of agro waste is generated yearly which has the potential to be used in biorefinery [3]. Generally,

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agro wastes are either incinerated or dumped in landfills to cause health and environmental issues for human beings [4]. Hence, utilizing them helps in the valorization of agro waste, in addition to the advanced waste management policy. However, utilization of this lignocellulosic biomass is hindered by its highly recalcitrant composition [5]. The complex arrangement of cellulose, hemicellulose, and lignin to prevent microbial and enzymatic attack provides resistance for the lignocellulosic biomass [5]. To overcome this and for enhancing the digestibility of biomass, several pretreatment techniques have been employed [6]. There have been advances in the pretreatment techniques employed, replacing the conventional pretreatment like milling, acid, alkaline, and organosolv pretreatment with more eco-friendly and recyclable solvents. These include ionic liquid, deep eutectic solvent and combinatorial pretreatments that can help in enhancing the digestibility of biomass and ease the conversion of biomass to fermentable sugars [6]. These fermentable sugars are further converted to value-added products.

Value-added products include biofuels, biochemicals, bioplastics, food flavours etc. Bioethanol, biobutanol, biokerosene and biogas are a few biofuels produced from lignocellulosic biomass [7]. Biochemicals such as hydroxymethylfurfural, levulinic acid, succinic acid, maleic acid, and lactic acid can also be produced from lignocellulosic biomass. Most of these biochemicals are intermediates in producing other organic chemicals or are used as additives, food flavours, pharmaceuticals, cosmetics, food processing etc. [8]. Despite the conversion of fermentable sugars, bioproducts can also be derived from cellulose, hemicellulose and lignin extracted from the biomass. Cellulose can be used in synthesizing various composites, adsorbents, and aerogels, which can be used in scaffolds, drug delivery, and biosensors [9]. Hemicellulose bioproducts find their main application in making films and hydrogels, which are used in the pharmaceutical industry [9]. Similarly, lignin-derived bioproducts include vanillin, nanoparticles, bioplastics, dyes and aerogels that can be used in various industries [9]. Thus, lignocellulosic biomass, which is considered of less value can be converted to high-value products.

Even though lignocellulosic biomass has the potential to produce various value-added products, its commercialization is still limited due to the lack of more advanced studies and technologies. Similarly, detailed techno-economic studies are also required before they commercialise them into the market. However, the use of suitable biomass, efficient and cost-effective pre-treatment technique coupled with an eco-friendly downstream process can help in the successful valorization of agro waste.

References

[1] United Nations. (2022, November). *THE 17 GOALS | Sustainable Development*. [Online]. Available: https://sdgs.un.org/goals

[2] Y. S. Cheng, P. Mutrakulcharoen, S. Chuetor, K. Cheenkachorn, P. Tantayotai, E. J. Panakkal, and M. Sriariyanun, "Recent situation and progress in biorefining process of lignocellulosic biomass: Toward green economy," *Applied Science and Engineering Progress*, vol. 13, no. 4, pp. 299–311, 2020 (in Thai).

[3] T. Phusantisampan and N. Kitiborwornkul, "Progress in chemical pretreatment of lignocellulose biomass for applications in biorefinery," *The Journal of KMUTNB*, vol. 32, no. 4. 2022 (in Thai).

[4] E. J. Panakkal, K. Cheenkachorn, M. P. Gundupalli, N. Kitiborwornkul, and M. Sriariyanun, "Impact of sulfuric acid pretreatment of durian peel on the production of fermentable sugar and ethanol," *Journal of the Indian Chemical Society*, vol. 98, no. 12, pp. 100264, 2021.

[5] A. Zoghlami and G. Paës, "Lignocellulosic biomass: Understanding recalcitrance and predicting hydrolysis," *Front Chem*, vol. 7, pp. 874, 2019.

[6] D. Jose, N. Kitiborwornkul, K. Katam, and M. Sriariyanun, "A review on chemical pretreatment methods of lignocellulosic biomass: Recent advances and progress," *Applied Science and Engineering Progress*, vol. 15, no. 4, Article no. 6210, 2022 (in Thai).

[7] T. Ruensodsai and M. Sriariyanun, "Sustainable development and progress of lignocellulose conversion to platform chemicals," *The Journal of KMUTNB*, vol. 32, no. 4, pp. 815–818, 2022 (in Thai).

[8] J. A. Okolie, A. Mukherjee, S. Nanda, A. K. Dalai, and J. A. Kozinski, "Next-generation biofuels and platform biochemicals from lignocellulosic biomass," *International Journal of Energy Research*, vol. 45, no. 10, pp. 14145–14169, 2021.

[9] V. Ashokkumar, R. Venkatkarthick, S. Jayashree, S. Chuetor, S. Dharmaraj, G. Kumar, W.-H. Chenh, and C. Ngamcharussrivichai, "Recent advances in lignocellulosic biomass for biofuels and value-added bioproducts - A critical review," *Bioresour Technol*, vol. 344, Article no. 26195, 2022.

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