Characterization of oil-palm trunk residue degradation enzymes from the isolated fungus, *Penicillum rolfsii*

Oil palm (*Elaeis guineensis*) used in palm oil production must be replanted at 20 to 25-year intervals in order to maintain oil productivity. Consequently, the felled palm trunks represent one of the most important biomass resources in Malaysia and Indonesia. Oil-palm trunk biomass consists of a complex network of cellulose, hemicellulose, and lignin, the major constituents of which are celluloses and hemicelluloses.

To utilize the felled palm trunks specifically for bioethanol and bioplastic production, and to exhibit the advantages of hydrolysis compared to using commercial enzymes, we characterized the crude ligno-cellulolytic enzyme of the fungal isolate *P. rolfsii* c3-2(1) IBRL utilizing oil-palm trunk residues.

We were able to show that the mesophilic fungus *P. rolfsii* c3-2(1) IBRL produces high activity enzymes (P. rolfsii) including xylanase, laminarinase, and arabinase. P. rolfsii displayed higher thermal stability compared with commercial enzymes, Celluclast 1.5 L and Acellerase 1500 (Fig.1). The effects of isolated lignin residual on biomass saccharification revealed that P. rolfsii possesses weak ‘lignin-binding’ enzymes that may contribute to their higher hydrolysis efficiency on oil-palm trunk residues (Fig. 2). The hydrolysis efficiency of P. rolfsii is 1- to 1.5-fold higher than that of commercial enzymes following 48–72 h of biomass saccharification (Fig. 3). These findings suggest that *P. rolfsii* c3-2(1) IBRL is a fungal strain isolate that can potentially be used as a microbial factory for ligno-cellulolytic enzyme production. Furthermore, *P. rolfsii* c3-2(1) IBRL may represent an alternative for biomass utilization, such as oil-palm trunk residues. The high performance of ligno-cellulolytic enzymes produced by *P. rolfsii* c3-2(1) IBRL deserves significant attention as an alternative to other commercial enzymes for the production of second-generation biofuels and bioplastic.

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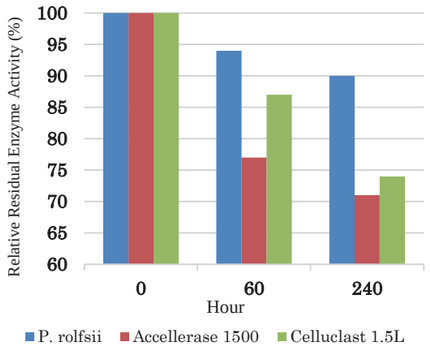

Fig. 1. Residual activity expressed as a percentage of the maximum oil-palm trunk residue activity by P. rolfsii c3-2(1)

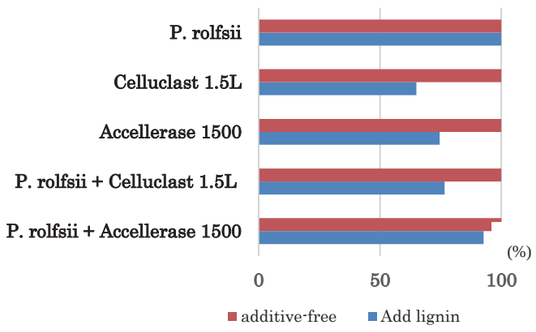

Fig 2. Absorption of P. rolfsii c3-2(1) IBRL enzymes and commercial enzymes on Klason lignin residues after 1.5 h at 4°C

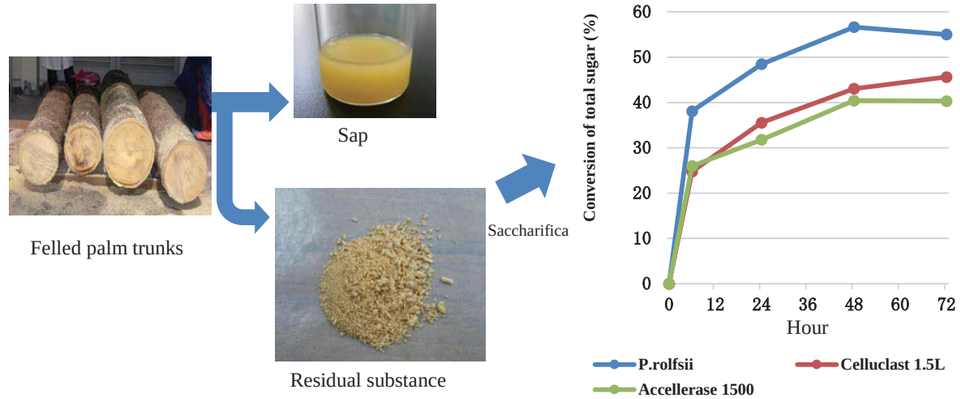

Fig. 3. Time course for the hydrolysis of oil-palm trunk residues using P. rolfsii c3-2(1) IBRL enzyme and commercial enzymes based on the hydrolysis of total sugar conversion (%)