Optimasi produksi enzim mannanase dari kitasatospora sp. pada limbah biomassa palm kernel meal (PKM) = Production optimization of mannanase enzyme from kitasatospora sp. through palm kernel meal (PKM) waste biomass.

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Abstrak

Palm Kernel Meal (PKM) merupakan by-product pengolahan minyak kernel sawit yang jarang dimanfaatkan. Penggunaan masih terbatas sebagai campuran pakan ternak dengan komposisi 3-5% dari total pakan. Hal ini disebabkan tingginya serat kasar mencapai kisaran 20-40% dari berat kering PKM. Padahal, PKM mengandung komposisi mannan dengan kandungan total 45-56% pada jaringan hemiselulosa. Pemanfaatan lebih lanjut biomassa PKM sebagai substrat produksi -mannanase dan menghasilkan turunan mannooligosakarida (MOS) sangat menjanjikan. Konsentrasi PKM sebagai substrat, pH, suhu inkubasi, dan penambahan mikropartikel Al2O3 sebagai faktor penentu simulasi RSM. Kondisi operasi terpilih menjadi basis scale-up produksi fermentor batch kapasitas 1,5 L dengan pengaruh laju aerasi 1,0 vvm. Disamping, itu dilakukan estimasi parameter kinetika pertumbuhan Kitasatospora sp. produksi aktivitas -mannanase dan substrat PKM terkonsumsi dengan asumsi model Logistik, Luedeking-Piret dan Modified Luedeking-Piret. Titik optimum yang diperoleh dilanjutkan dengan purifikasi parsial. Setelah itu, hidrolisis PKM dilakukan untuk mengamati sinergisitas pelarut NaOH-HCl dengan enzim sebagai ekstraktor turunan mannan. Simulasi menunjukkan 3% (w/v) PKM, pH 6,5, suhu 34 °C, dan 0,2% (v/v) Al2O3 merupakan kondisi terpilih untuk scale-up. Pada fermentor 1,5 L setelah melalui pemurnian parsial, diperoleh aktivitas tertinggi 44,34 U/mL, laju aktivitas 0,302 U/mL-1 jam-1, konsentrasi delta gula total (S) 39,17 gr/L, dan SUY 78,15%. Estimasi kinetika dari fitting model terukur µmax, Xo, Xmax, , , Z, dan secara berurutan adalah 0,0492 jam-1; 0,435 gr/L; 8,93 gr/; 0,085 U/mgX.jam; 4,467 U/mgX; 0,026 grS/grX.jam; dan 4,328 grS/grX. Adapun hasil hidrolisis zona bening dan TLC menunjukkan kemampuan -mannanase yang disintesis Kitasatospora sp. menghasilkan turunan MOS yang didominasi mannobiosa (M2), dengan 72 jam pembentukan dari bantuan pelarut.

.....Palm Kernel Meal (PKM), called as by-product from palm kernel oil processing, which is rarely being utilized. The usage is limited as livestock feed’s blend with composition accounted only 3-5% off from total feed. The problem lies on the high content of crude fibres, up to 20-40% of PKM’s dry matter. Meanwhile, PKM contains relatively high mannan comprises around 45-56% from hemicellulose’s tissue. Further application of PKM biomass as substrate for -mannanase production and resulting any derivatives of mannooligosaccharides (MOS) are very promising. Substrate, initial pH, incubation temperature, and additional microparticle Al2O3 were determined as independent factors for RSM simulation. The chosen condition was used for scalled-up through 1,5 L stirred tank-bioreactor batch, 1,0 vvm aeration rate. The kinetics parameters of Kitastospora sp. growth, enzyme production and substrate consumption were estimated through Logistic, Luedeking-Piret, and Modified Luedeking-Piret model assumption. The optimal point obtained was continued by partial purification. Subsequently, PKM hydrolysis was also done to observe synergistic enzyme effect with NaOH-HCl solvent-assisted for mannan’s derivative produced. The evidence showed 3% (w/v) PKM, pH 6.5, 34 °C, and 0.2% (v/v) Al2O3 were the best operating for -

mannanase production. Further confirmation in scale-up phase indicated the highest enzyme activity, rate of production, total sugar concentration, and SUY were calculated as 44.34 U/mL, 0.302 U/mL-1 hr-1, 39.17 g/L and 78.15%, respectively. Kinetics production parameter components, comprised as μmax, Xo, Xmax, , , Z, and , were expected around 0,0492 hr-1; 0,435 g/L; 8,93 g/; 0,085 U/mgX.hr; 4,467 U/mgX; 0,026 gS/gX.hr; dan 4,328 gS/gX, respectively. From clear zone and TLC experimental, it proved that the enzyme was capable to produce MOS from PKM, mainly mannobiose (M2) with extension of 72 hours duration by solvent-assisted enzymatic reaction.