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## LAMPIRAN

### Lampiran 1. Prosedur Kerja Penelitian



Gambar 1. Limbah alga *K. alvarezii*



Gambar 2. Perendaman dan pencucian limbah alga *K. alvarezii*



Gambar 3. Limbah alga *K. alvarezii* dikeringkan dengan menggunakan oven



Gambar 4. Proses penghalusan dan pengayakan limbah alga *K. alvarezii* dengan ayakan 40 mesh



Gambar 5. Proses penimbangan 50 gram tepung alga *K. alvarezii*



Gambar 6. Proses pemanasan tepung alga *K. alvarezii* menggunakan 50 gram tepung alga dan 1.950 ml aquades dengan *water batch* selama 2 jam pada suhu 100°C



Gambar 7. Hasil proses pemanasan tepung alga



Gambar 8. Botol fermentor yang berisi medium fermentasi



Gambar 9. Proses sterilisasi medium fermentasi menggunakan *autoclave*



Gambar 10. Proses aktivasi isolat *T. reesei*



Gambar 11. Proses inokulasi *T. reesei* kedalam botol fermentor yang berisi medium fermentasi



Gambar 12. Proses hidrolisis dengan *Trichoderma reesei* pada suhu  $\pm 30^{\circ}\text{C}$  (suhu ruang)

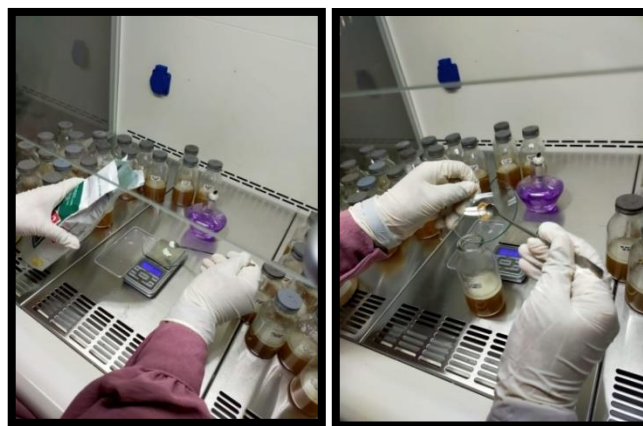




Gambar 13. Proses aktivasi *P. kudriavzevii* dengan aquades steril



Gambar 14. Proses inokulasi *P. kudriavzevii* kedalam botol fermentor yang telah dihidrolisis *T. reesei*

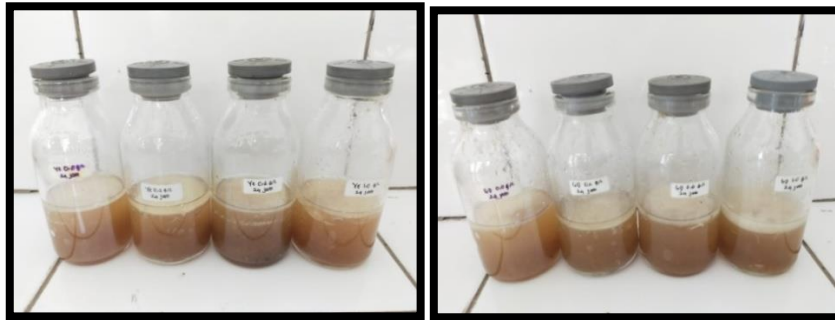


Gambar 15. Proses penambahan nutrisi fermentasi yeast extract dan Gandasil-D<sup>®</sup> sesuai dengan konsentrasi ( 0,0 g/L; 0,2 g/L; 0,6 g/L dan 1,0 g/L) kedalam setiap botol fermentor

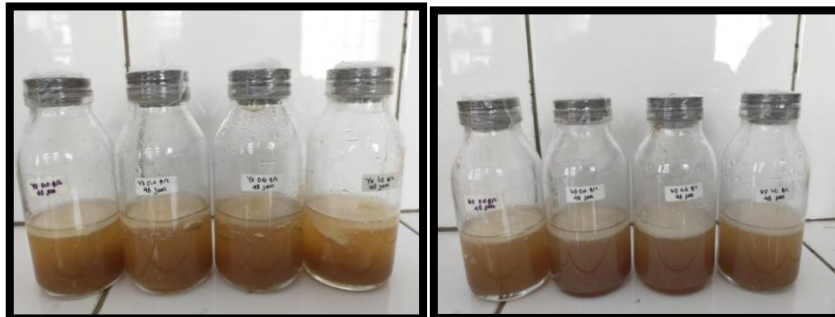




Gambar 16. Sampel yang difermentasi selama 0 jam



Gambar 17. Sampel yang telah difermentasi selama 24 jam



Gambar 18. Sampel yang telah difermentasi selama 48 jam



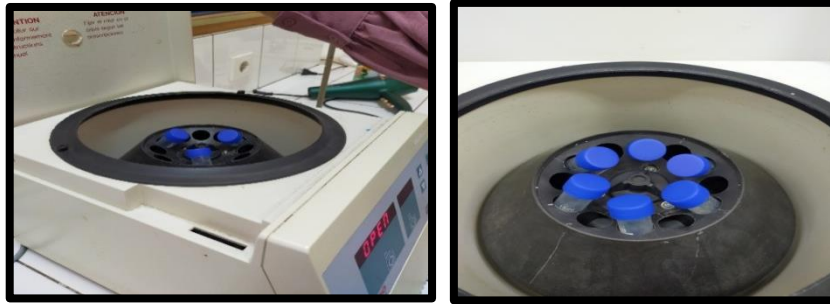
Gambar 19. Sampel yang telah difermentasi selama 72 jam



Gambar 20. Sampel yang telah difermentasi selama 96 jam



Gambar 21. Sampel yang telah difermentasi selama 120 jam



Gambar 22. Proses sentrifugasi



Gambar 23. Pengukuran kadar etanol dan kadar gula

## Lampiran 2. Rumus Menghitung Nilai Yp/s, Konsumsi Gula dan Efisiensi Fermentasi

$$Y_{p/s} = \frac{\text{Produk}}{\text{Substrat}} \\ = \frac{\text{Bioetanol}}{\text{Gula pada saat 0 jam} - \text{Gula saat etanol maksimal dicapai}}$$

$$\text{Konsumsi gula} = \frac{\text{Gula Awal} - \text{Gula Max. Etanol}}{\text{Gula Awal}} \times 100\%$$

$$\text{Efisiensi Fermentasi} = \frac{Y_{p/s}}{0,511} \times 100\%$$

## RIWAYAT HIDUP



Nama lengkap penulis adalah Alkawi, kelahiran 14 April 2000 di Desa Amesiu, Kecamatan Pondidaha, Kabupaten Konawe, Provinsi Sulawesi Tenggara. Penulis lahir dari pasangan Bapak Piyt supu dan Ibu Sumiati yang merupakan anak keempat dari enam bersaudara. Pada tahun 2005 penulis memulai pendidikan formal pada jenjang sekolah dasar di SD Negeri 3 Wawolemo (2005-2011), jenjang sekolah lanjut tingkat pertama di SMP Negeri 1 Pondidaha (2011-2014), dan jenjang sekolah lanjut tingkat atas di SMA Negeri 1 Pondidaha (2014-2017). Setelah selesai menempuh pendidikan menengah atas, penulis melanjutkan Pendidikan Strata (S1) Program Studi Biologi Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Sam Ratulangi Manado mulai dari tahun (2017-2021) dan meraih gelar Sarjana Sains (S.Si), serta saat ini penulis dalam tahap penyelesaian studi akhir jenjang pendidikan Strata (S2) untuk gelar Magister Sains (M.Si) di Program Studi Magister Biologi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Hasanuddin, Makassar.

Email Penulis:

[alkawi1404@gmail.com](mailto:alkawi1404@gmail.com).