DAFTAR PUSTAKA

Adna, R. M., Prahastiwi, V. I., Nazzala, A. N., Fatihatunisa, R., Azzahro, S., & Aini, N. (2021). Potensi Penambahan Berbagai Jenis Gula terhadap Sifat Sensori dan Fisikokimia Roti Manis: Review. In *Pasundan Food Technology Journal (PFTJ)* (Vol. 8, Issue 3).

Adrian, Syaiful, A. Z., Ridwan, & Hermawati. (2020). Sakarifikasi pati ubi jalar putih menjadi gula dekstrosa secara enzimatis. *SAINTIS*, *1*(1).

Akyuni, D. (2004). *Pemanfaatan pati sagu (Metroxylon sp.) untuk pembuatan sirup glukosa menggunakan alfa amilase dan amiloglukosidase*. Institut Pertanian Bogor.

Amarakone, S. P., Ishigami, H., & Kainuma, K. (1984). Conversion of Oligosaccharides Formed during Starch Hydrolysis by a Dual Enzyme System*. In *J. Jpn. Soc. Starch Sci* (Vol. 31, Issue 1).

Anklam, E. (2005). H.-D. Belitz, W. Grosch, P. Schieberle: Food Chemistry, Third Edition. *Analytical and Bioanalytical Chemistry*, *382*(1), 10–11. https://doi.org/10.1007/s00216-004-3036-9

Apriyadi, S. S. A. (2020). Likuifikasi Pati Ubi Jalar Putih secara Enzimatis Menggunakan Enzim α-Amilase. In *SAINTIS* (Vol. 1, Issue 1).

Ardiansyah, A. (2007). *Optimasi karbonatasi untuk pemucatan raw sugar dengan menggunakan reaktor venturi bersirkulasi*. Institut Pertanian Bogor.

Aryanika, I. W. W., Gunam, B. W., & Suhendra, L. (2022). *The Effect of Amylase Enzyme Concentration and Hydrolisis Time of Rubber Singkong (Manihot Glaziovii Muell. ARG) Starch on Total Reducing Sugar Produced* (Vol. 10, Issue 4).

Azwar, D., & Erwanti, R. (2009). Pembuatan sirup glukosa dari kimpul (Xanthosoma violaceum Schott) dengan hidrolisa enzimatis. *Eprints Universitas Diponegoro*.

Az'zahrah, N. R., Dewi, E., & Yerizam, M. (2024). Pengolahan Pati Rumbia menjadi Serbuk Glukosa secara Hidrolisis Enzimatis dengan Variasi Perbandingan Pati dan Air, Suhu Evaporasi, dan Suhu Pengeringan. *Jurnal Teknik Kimia USU*, *13*(1), 24–31. https://doi.org/10.32734/jtk.v13i1.13327

Baker, W. (2001). *Membrane Technology and Application*. Mc Graw.

Bakr, A. (2014). Performance of starch hydrolysis and production of corn syrup using some commercial enzymes. In *International Food Research Journal* (Vol. 21, Issue 2).

Baks, T., Bruins, M. E., Matser, A. M., Janssen, A. E. M., & Boom, R. M. (2008). Effect of Gelatinization and Hydrolysis Conditions on the Selectivity of Starch Hydrolysis with α-Amylase from Bacillus licheniformis. *Journal of Agricultural and Food Chemistry*, *56*(2), 488–495. https://doi.org/10.1021/jf072217j

Baks, T., Kappen, F. H. J., Janssen, A. E. M., & Boom, R. M. (2008). Towards an optimal process for gelatinisation and hydrolysis of highly concentrated starch–water mixtures with alpha-amylase from B. licheniformis. *Journal of Cereal Science*, *47*(2), 214–225. https://doi.org/10.1016/j.jcs.2007.03.011

BeMiller, J., & Whistler, R. (2009). *Starch: Chemistry and Technology* (third edition). Academic Press.

Betiku, E., Akindolani, O. O., & Ismaila, A. R. (2013). Enzymatic hydrolysis optimization of sweet potato (Ipomoea batatas) peel using a statistical approach. *Brazilian Journal of Chemical Engineering*, *30*(3), 467–476. https://doi.org/10.1590/S0104-66322013000300005

Bláhová, M., Štefuca, V., Hronská, H., & Rosenberg, M. (2023). Maltooligosaccharides: Properties, Production and Applications. *Molecules*, *28*(7), 3281. https://doi.org/10.3390/molecules28073281

Bueno-Zabala, K. A., Lopresto, C. G., Calabro, V., Curcio, S., Ruiz-Colorado, A. A., & Chakraborty, S. (2020a). Optimized Production of Glucose Syrup and Enzyme Membrane Reactor Using In Situ Product Recovery. *Industrial & Engineering Chemistry Research*, *59*(49), 21305–21311. https://doi.org/10.1021/acs.iecr.0c04636

Carina Pavezzi, F., Gomes, E., & da Silva, R. (2008). Production and Characterization of Glucoamylase from fungus Aspergillus Awamori Expressed in Yeast Saccharomyces Cerevisiae Using Different carbon Source. *Brazilian Journal of Microbiology*, *39*, 108–114.

Chaplin, M. F., & Bucke, C. (1990). *Enzyme Technology*. Cambridge University Press.

Dalimunthe, L. H., Rana, G. K., Ekasari, N., Iskak, P. I., & Andriani, J. (2019). *Buku Sagu (Metroxylon sagu Rottb.)*. Pusat perpustakaan dan penyebaran teknologi pertanian.

de Cazes, M., Belleville, M.-P., Petit, E., Llorca, M., Rodríguez-Mozaz, S., de Gunzburg, J., Barceló, D., & Sanchez-Marcano, J. (2014). Design and optimization of an enzymatic membrane reactor for tetracycline degradation. *Catalysis Today*, *236*, 146–152. https://doi.org/10.1016/j.cattod.2014.02.051

de la Rosa-Millán, J., Orona-Padilla, J. L., Flores-Moreno, V. M., & Serna-Saldívar, S. O. (2020). Effect of jet-cooking and hydrolyses with amylases on the physicochemical and *in vitro* digestion performance of whole chickpea flours. *International Journal of Food Science & Technology*, *55*(2), 690–701. https://doi.org/10.1111/ijfs.14338

Delft, L. (1985). Conversion of liquified starch into glucose using a novel glucoamylase system. *Starke*, *37*(5), 157–161.

Devita, C. (2015). *Perbandingan metode hidrolisis enzim dan asam dalam pembuatan sirup glukosa ubi jalar ungu*. Universitas Negeri Semarang.

Djalal, M., Wakiah, N., Laga, A., & Bastian, F. (2019). The effect of heating on the effectiveness of coal activated charcoal on glucose syrup purification. *IOP Conference Series: Earth and Environmental Science*, *343*(1), 012072. https://doi.org/10.1088/1755-1315/343/1/012072

Elisanti, A. D., Ardianto, E. T., & Rindiani, R. (2023). Brix level on dragon fruit and moringa oleifera soft candy to prevent children dental caries. *IOP Conference Series: Earth and Environmental Science*, *1168*(1). https://doi.org/10.1088/1755-1315/1168/1/012038

Fatourehchi, F., Farrokhi, F., Eyvazzadeh, O., Bahadori, A., & Yaghoubi, A. S. A. (2022). Production of Glucose Syrup through Enzymatic Hydrolysis of Flint and Floury Corn Flour Mixtures and Evaluating its Properties as Cost-Effective Syrup. *Journal of Food Science and Technology (Iran)*, *19*(129), 23–39. https://doi.org/10.22034/FSCT.19.129.23

Fransiska, A., Jimmy, F. W., & Alexander, R. (2020). Budidaya dan Pemanfaatan Sagu (Metroxylon Sp.) oleh Sub-Etnis Ayamaru di Kampung Sembaro Distrik Ayamaru Selatan. *JURNAL KEHUTANAN PAPUASIA*, *4*(2), 114–127. https://doi.org/10.46703/jurnalpapuasia.Vol4.Iss2.100

Fridayani. (2006). *Produksi sirup glukosa dari pati sagu yang berasal dari beberapa wilayah di Indonesia*. Institut Pertanian Bogor.

Fullbrook, P. D. (1984). *The enzymatic production of glucose syrup*. Elsevier Applied Science Publishers.

Hargono, H., Jos, B., Satriadi, H., & Zakaria, M. F. (2022). The Analysis of Na and Ca Ions Addition on Cassava Hydrolysis on Reducing Sugar Concentration to Increase Enzyme Activity: Hydrolysis Kinetics Study. *TEKNIK*, *43*(1), 17–24. https://doi.org/10.14710/teknik.v43i1.41985

Hartati, I., Yulianto, M. E., Kurniasari, L., & Riwayati, I. (2008). Kajian Hidrolisa Starch Sagu Oleh Enzim Glucoamylase Dan Pullulanase Untuk Produksi Asam Organik. *Jurnal Momentum UNWAHAS*, *4*(1). https://doi.org/10.36499/jim.v4i1.627

Hernández, D., Riaño, B., Coca, M., & García-González, M. C. (2015). Saccharification of carbohydrates in microalgal biomass by physical, chemical and enzymatic pre-treatments as a previous step for bioethanol production. *Chemical Engineering Journal*, *262*, 939–945. https://doi.org/10.1016/j.cej.2014.10.049

Hull, P. (2010). *Glucose syrup: Technology and Applications*. Wiley Blackwell.

Jading, A., Tethool, E., Payung, P., & Gultom, S. (2011). Karakteristik Fisikokimia Pati Sagu Hasil Pengeringan Secara Fluidisasi Menggunakan Alat Pengering Cross Flow Fluidized Bed Bertenaga Suraya dan Biomassa. *Reaktor*, *13*(3), 155. https://doi.org/10.14710/reaktor.13.3.155-164

Jariyah, & Nurismanto, R. (2017). Produksi sirup glukosa hasil hidrolisis enzimatis pati garut. *Jurnal Teknologi Pertanian*, *6*(2), 1–11.

Jaywant, S. A., Singh, H., & Arif, K. M. (2022). Sensors and Instruments for Brix Measurement: A Review. In *Sensors* (Vol. 22, Issue 6). MDPI. https://doi.org/10.3390/s22062290

Kusmiyati, & Mahmudi, A. (2014). Bioethanol Production from Iles-Iles and Sorghum Starch as Raw Materials (Effect of CaCl 2 Addition and Saccharification Time). *Makara Journal of Technology*, *18*(1). https://doi.org/10.7454/mst.v18i1.2938

Kusumawaty, Y., Maharani, E., & Edwina, S. (2019). Processing of sugar from sago palm starch and development suggestion in Sei Tohor village, Tebing Tinggi Timur sub-district, Kepulauan Meranti, Riau. *Prosiding Forum Komunikasi Perguruan Tinggi Pertanian Indonesia*.

Laga, A. (2024). *Teknologi Pengolahan Pati*. Penerbit Inzani.

Liu, H., Yu, L., Dean, K., Simon, G., Petinakis, E., & Chen, L. (2009). Starch gelatinization under pressure studied by high pressure DSC. *Carbohydrate Polymers*, *75*(3), 395–400. https://doi.org/10.1016/J.CARBPOL.2008.07.034

Liu, Y., Zhang, F., Jiang, L., Perry, J. J. P., Zhao, Z., & Liao, J. (2021). Product inhibition kinetics determinations - Substrate interaction affinity and enzymatic kinetics using one quantitative FRET assay. *International Journal of Biological Macromolecules*, *193*, 1481–1487. https://doi.org/10.1016/j.ijbiomac.2021.10.211

Magwaza, L. S., & Opara, U. L. (2015). Analytical methods for determination of sugars and sweetness of horticultural products-A review. In *Scientia Horticulturae* (Vol. 184, pp. 179–192). Elsevier. https://doi.org/10.1016/j.scienta.2015.01.001

Megavitry, R. (2018). *Glucose syrup production from sago with the effect of gelatinization temperature and substrate concentration*. Hasanuddin University.

MSDS Glucose. (2013). *Glucose Material Safety Data Sheet*. Acros Organics.

Muhammad, K., Karim, R., & Tasnim, T. (2018a). *Review Paper Fungal Glucoamylase Production and Characterization: A Review. Corresponding author* (Vol. 591, Issue 2). www.bioresearchcommunications.com

Muhammad, K., Karim, R., & Tasnim, T. (2018b). *Review Paper Fungal Glucoamylase Production and Characterization: A Review. Corresponding author* (Vol. 591, Issue 2). www.bioresearchcommunications.com

Mukarrmah, Ansharulla, & Rianda, L. (2016). Pengaruh Penambahan Enzim Alfa Amilase pad Suhu yang berbeda Terhadap Karakteristik Sirup Glukosa. *J. Sains Dan Teknologi Pangan*, *13*, 246–254.

Nakamura, N., Sashihara, N., Nagayama, H., & Horikoshi, K. (1989). Characterization of Pullulanase and α-Amylase Activities of a *Thermus* sp. AMD33. *Starch - Stärke*, *41*(3), 112–117. https://doi.org/10.1002/star.19890410310

Ni'maturrohmah, E., & Yunianta. (2014). Hidrolisis Pati Sagu (Metroxylon sagu Rottb.) Oleh Enzim B-Amilase Untuk Pembuatan Dekstrin. *Jurnal Pangan Dan Agroindustri*, *3*(1), 292–302.

Oktafiani, N. I. E. (2023). characterization results and determination of saccharification reaction rate of suweg (amorphophallus campanulatus B1) rubers into glucose syrup. *UNESA Journal of Chemistry*, *2*(3).

Omemu, A. M., Akpan, I., Bankole, M. I., & Teniola, O. D. (2005). Hydrolisis of raw tuber starches by amylase of Aspergillus niger AM07 isolated from the soil. *African Journal of Biotechnology*, *4*(1), 19–25.

Palguna, A., Sugiyono, & Hariyanto, B. (2014). Karakteristik pati sagu yang dimodifikasi dengan perlakuan gelatinisasi dan retrogradasi berulang. *PANGAN*, *23*, 146–157.

Pandey, A., & Trivandrum. (1995). Glucoamylase Research: An Overview. *Starke*, *47*(11), 439–445.

Raharja, S., Suryadarma, P., & Oktavia, D. T. (2011). Enzymatic Hydrolysis of Fish Oil for Production of Omega-3 Fatty Acids Using Lipase Derived from Aspergillus niger. In *Hasil Penelitian J. Teknol. dan Industri Pangan: Vol. XXII*.

Ramadhan, B., & Wikandari, P. R. (2021). Review Artikel: Aktivitas Enzim Amilase dari Bakteri Asam Laktat (Karakteristik dan Aplikasi). *Unesa Journal of Chemistry*, *10*(2), 109–120. https://doi.org/10.26740/ujc.v10n2.p109-120

Rani, K., Rana, R., & Datt, S. (n.d.). *Review on Characteristics and Application of Amylases*. http://www.bretj.com

Rezaei, K., Jenab, E., & Temelli, F. (2007). Effects of water on enzyme performance with an emphasis on the reactions in supercritical fluids. In *Critical Reviews in Biotechnology* (Vol. 27, Issue 4, pp. 183–195). https://doi.org/10.1080/07388550701775901

Rosida, D. F., & Amelia, R. (2022). *Glucose Syrup of Annealing Modified of Cocoyam (Xanthosoma sagittifolium) Starch*. https://doi.org/10.2991/absr.k.220101.037

Saha, B. C., Zeikus, J. G., & Lansing. (1989). Microbial glucoamylases: Biochemical and biotechnological features. *Starke*, *41*(2), 57–64.

Sampedro, J. G., Rivera-Moran, M. A., & Uribe-Carvajal, S. (2020). Kramers' theory and the dependence of enzyme dynamics on trehalose-mediated viscosity. In *Catalysts* (Vol. 10, Issue 6, pp. 1–19). MDPI. https://doi.org/10.3390/catal10060659

Saraswati, Rosidah, I., & Hapsari, D. Y. (2004). Pembuatan glukosa secara enzimatik dari bahan baku pati sagu. *FTI Insititut Teknologi Sepuluh November*.

Schartges, D., & Berglund, K. A. (1989). Solubility of Maltose in Water in the Presence of Glucose and Maltotriose. *Starch - Stärke*, *41*(11), 436–438. https://doi.org/10.1002/star.19890411109

Sellerberg, M., Di Bartolo, D., Oberrecht, J., Tiller, J., & Walzel, P. (2014). Viscometric measurement of protease activities on gelatine substrate. *Applied Rheology*, *24*(6). https://doi.org/10.3933/APPLRHEOL-24-62660

Silva, S. P., Moreira, A. S. P., Domingues, M. D. R. M., Evtuguin, D. V., Coelho, E., & Coimbra, M. A. (2019). Contribution of non-enzymatic transglycosylation reactions to the honey oligosaccharides origin and diversity. *Pure and Applied Chemistry*, *91*(7), 1231–1242. https://doi.org/10.1515/pac-2019-0209

Simtadegi, U. D. (2015). *Pengaruh penggunaan jenis enzim dan lama sakarifikasi terhadap produksi sirup glukosa dengan sistem batch pada skala pilot*. Hasanuddin University.

Sirohi, R., Pandey, J. P., Goel, R., Singh, A., Lohani, U. C., & Kumar, A. (2021). Two-Stage Enzymatic Hydrolysis for Fermentable Sugars Production from Damaged Wheat Grain Starch with Sequential Process Optimization and Reaction Kinetics. *Starch - Stärke*, *73*(1–2). https://doi.org/10.1002/star.202000082

Sitanggang, A. B., Drews, A., & Kraume, M. (2022). Enzymatic membrane reactors: Designs, applications, limitations and outlook. *Chemical Engineering and Processing - Process Intensification*, *180*, 108729. https://doi.org/10.1016/j.cep.2021.108729

SNI 2978. (2021). *Sirup Glukosa*. Badan Standaridasi Nasional.

Son, H. S., Hong, Y. S., Park, W. M., Yu, M. A., & Lee, C. H. (2009). A Novel Approach for Estimating Sugar and Alcohol Concentrations in Wines Using Refractometer and Hydrometer. *Journal of Food Science*, *74*(2). https://doi.org/10.1111/j.1750-3841.2008.01036.x

Sudaryati, Jariyah, & Setiyowati, T. M. (2014). Purification glucose syrup using ultrafiltration membrane. *J.REKAPANGAN*, *8*(2), 165–170.

Sugiyono. (2004). *Buku ajar kimia pangan*. Universitas Negeri Yogyakarta.

Umar, D. N. M. (2020). *Penjernihan maltodekstrin sagu (Metroxylon sp.) dengan teknik adsorpsi dan filtrasi menggunakan arang aktif dan zeolit*. Universitas Hasanuddin.

Uribe, S., & Sampedro, J. G. (2003). Measuring Solution Viscosity and its Effect on Enzyme Activity. In *Biological Procedures Online* • (Vol. 5, Issue 1). www.biologicalprocedures.com

Vamos, L., & Rose, P. (1973). Investigations into and an enzymic assay method of transglucosidase activity of commercial glucoamylase preparations. *Starke*, *25*(6), 195–202.

Wahyuni, S. (2017). *Biokimia enzim dan karbohidrat*. Unimal Press.

Winarno, F. G. (2004). *Kimia Pangan dan Gizi*. Gramedia.

Wulansari, I. (2004). *Kajian pengaruh dosis alfa amilase dan dextrozyme pada pembuatan sirup glukosa dari pati sagu (Metroxylon sp.)*. Institut Pertanian Bogor.

Yuansah, S. C. (2023). *Changes in structure and kinetics of enzyme mixtures during the hydrolysis process of sago pith flour (Metroxylon sp.)*. Hasanuddin University.

Zelvi, M., Suryani, A., & Dwi, D. (2017). Hydrolisis of Eucheuma cottonii by K-Carragenase in Produce Reducing Sugar to Production of Bioethanol. *Setyaningsih Jurnal Teknologi Industri Pertanian*, *27*(1), 33–42.

Lampiran

Tahap I. Pengaruh konsentrasi substrat pati sagu dan lama sakarifikasi

Lampiran 1. Perolehan nilai gula pereduksi (g/L) sirup glukosa dengan variasi konsentrasi substrat pati sagu

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (g/L)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (g/L)
		1	2				1	2	
15	0	54.51	53.4	53.96	25	0	90.16	90.44	90.30
	6	65.39	67.01	66.20		6	96.34	92.71	94.53
	12	73.77	71.5	72.64		12	93.88	98.29	96.09
	18	79.65	79.65	79.65		18	92.84	98.22	95.53
	24	84.51	87.19	85.85		24	95.37	103.02	99.20
	30	84.46	85.48	84.97		30	105.48	97.05	101.27
	36	83.81	86.69	85.25		36	102.3	95.5	98.90
	42	85.44	83.44	84.44		42	106.26	103.92	105.09
	48	87.61	87.43	87.52		48	105.48	105.41	105.45
	54	88.17	85.71	86.94		54	105.61	106.71	106.16
	60	90.99	85.62	88.31		60	104.57	108.14	106.36
	66	90.71	86.08	88.40		66	111.83	106.45	109.14
	72	90.16	86.69	88.43		72	113.52	108.66	111.09

Lanjutan Tabel

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (g/L)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (g/L)
		1	2				1	2	
20	0	72.29	72.94	72.62	30	0	109.32	111.82	110.57
	6	74.52	78.86	76.69		6	115.79	114.47	115.13
	12	82.80	84.86	83.83		12	112.60	117.25	114.93
	18	85.02	85.86	85.44		18	118.57	112.25	115.41
	24	90.47	87.69	89.08		24	121.14	114.89	118.02
	30	87.47	86.08	86.78		30	119.26	117.74	118.50
	36	88.24	86.69	87.47		36	121.21	122.94	122.08
	42	88.69	86.47	87.58		42	126.84	123.07	124.96
	48	91.36	87.13	89.25		48	131.96	121.59	126.78
	54	89.02	89.58	89.30		54	132.77	124.18	128.48
	60	89.52	86.08	87.80		60	128.25	129.66	128.96
	66	90.52	87.41	88.97		66	134.7	134.25	134.48
	72	88.97	88.47	88.72		72	133.44	130.99	132.22

Lampiran 2. Nilai rataan hubungan antara variasi konsentrasi substrat pati sagu dan lama sakarifikasi terhadap nilai gula pereduksi (g/L)

Lama Sakarifikasi (jam)	Konsentrasi Substrat (%)				Rataan
	15	20	25	30	
0	53.96	72.62	90.30	110.57	**81.86**
6	66.20	76.69	94.53	115.13	**88.14**
12	72.64	83.83	96.09	114.93	**91.87**
18	79.65	85.44	95.53	115.41	**94.01**
24	85.85	89.08	99.20	118.02	**98.04**
30	84.97	86.78	101.27	118.50	**97.88**
36	85.25	87.47	98.90	122.08	**98.42**
42	84.44	87.58	105.09	124.96	**100.52**
48	87.52	89.25	105.45	126.78	**102.25**
54	86.94	89.30	106.16	128.48	**102.72**
60	88.31	87.80	106.36	128.96	**102.85**
66	88.40	88.97	109.14	134.48	**105.24**
72	88.43	88.72	111.09	132.22	**105.11**
Rataan	**80.96**	**85.65**	**101.47**	**122.34**	

Lampiran 3a. Analisa sidik ragam pengaruh konsentrasi pati sagu (%) dan lama sakarifikasi (jam) terhadap perolehan nilai gula pereduksi (g/L) sirup glukosa

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	65667.187[a]	51	1287.592	120.587	.000
Intercept	1981582.566	1	1981582.566	185581.976	.000
Konsentrasi	54425.935	3	18141.978	1699.058	.000*
Waktu	9318.126	12	776.511	72.723	.000*
Konsentrasi * Waktu	1923.125	36	53.420	5.003	.000*
Error	1665.716	156	10.678		
Total	2048915.469	208			
Corrected Total	67332.903	207			

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berpengaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 3b. Analisa lanjutan duncan pengaruh konsentrasi substrat terhadap gula pereduksi (g/L)

Konsentrasi Substrat (%)	N	Subset			
		1	2	3	4
15%	52	80.9642			
20%	52		85.6533		
25%	52			101.4704	
30%	52				122.3442
Sig.		1.000	1.000	1.000	1.000

Lampiran 3c. Analisa lanjutan duncan pengaruh lama sakarifikasi terhadap gula pereduksi (g/L)

Waktu (jam)	N	Subset							
		1	2	3	4	5	6	7	8
0 jam	16	81.86							
6 jam	16		88.13						
12 jam	16			91.86					
18 jam	16			94.00					
30 jam	16				97.87				
24 jam	16				98.03				
36 jam	16				98.42	98.42			
42 jam	16					100.51	100.51		
48 jam	16						102.24		
54 jam	16						102.71	102.71	
60 jam	16						102.85	102.85	102.85
72 jam	16							105.11	105.11
66 jam	16								105.24
Sig.		1.000	1.000	0.066	0.661	0.072	0.066	0.054	0.051

Lampiran 3d. Analisa lanjutan duncan pengaruh interaksi konsentrasi substrat lama sakarifikasi terhadap gula pereduksi (g/L)

Gula Pereduksi																				
Duncan[a,b]																				
Perlakuan	N	Subset																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
S1T0	2	53.96																		
S1T1	2		66.20																	
S2T0	2			72.62																
S1T2	2			72.64																
S2T1	2			76.69	76.69															
S1T3	2				79.65	79.65														
S2T2	2					83.83	83.83													
S1T7	2					84.44	84.44													
S1T5	2					84.97	84.97													
S1T6	2					85.25	85.25													
S2T3	2					85.44	85.44													
S1T4	2					85.85	85.85													
S2T5	2						86.78													
S1T9	2						86.94													
S2T6	2						87.47													
S1T8	2						87.52													
S2T7	2						87.58													
S2T10	2						87.80													

S1T10	2						88.31	88.31											
S1T11	2						88.40	88.40											
S1T12	2						88.43	88.43											
S2T12	2						88.72	88.72											
S2T11	2						88.97	88.97											
S2T4	2						89.08	89.08											
S2T8	2						89.25	89.25											
S2T9	2						89.30	89.30											
S3T0	2						90.30	90.30	90.30										
S3T1	2							94.53	94.53	94.53									
S3T3	2								95.53	95.53	95.53								
S3T2	2								96.09	96.09	96.09								
S3T6	2									98.90	98.90								
S3T4	2									99.20	99.20								
S3T5	2										101.27	101.27							
S3T7	2											105.09	105.09						
S3T8	2											105.45	105.45						
S3T9	2											106.16	106.16						
S3T10	2											106.36	106.36						
S3T11	2												109.14	109.14					
S4T0	2												110.57	110.57					
S3T12	2												111.09	111.09					
S4T2	2													114.93	114.93				
S4T1	2													115.13	115.13				

S4T3	2													115.41	115.41					
S4T4	2														118.02	118.02				
S4T5	2														118.50	118.50				
S4T6	2															122.08	122.08			
S4T7	2																124.96	124.96		
S4T8	2																126.78	126.78	126.78	
S4T9	2																	128.48	128.48	128.48
S4T10	2																	128.96	128.96	128.96
S4T12	2																		132.22	132.22
S4T11	2																			134.48
Sig.		1.000	1.000	0.173	0.293	0.058	0.064	0.064	0.062	0.141	0.070	0.109	0.066	0.052	0.261	0.175	0.116	0.197	0.079	0.053

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- T0 (0 jam), T1 (6 jam), T2 (12 jam), T3 (18 jam), T4 (24 jam), T5 (30 jam), T6 (36 jam), T7 (42 jam), T8 (48 jam), T9 (54 jam), T10 (60 jam), T11 (66 jam), dan T12 (72 jam)

Lampiran 4. Perolehan nilai dekstrosa ekuivalen (%) sirup glukosa dengan variasi konsentrasi substrat pati sagu

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (%)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (%)
		1	2				1	2	
15	0	36.34	35.6	35.97	25	0	36.06	36.17	36.12
	6	43.59	44.67	44.13		6	38.54	37.08	37.81
	12	49.18	47.67	48.43		12	37.55	39.31	38.43
	18	53.1	53.1	53.10		18	37.14	39.29	38.22
	24	56.34	58.13	57.24		24	38.15	41.21	39.68
	30	56.31	56.99	56.65		30	42.19	38.82	40.51
	36	55.88	57.79	56.84		36	40.92	38.2	39.56
	42	56.96	55.63	56.30		42	42.5	41.57	42.04
	48	58.41	58.28	58.35		48	42.19	42.17	42.18
	54	58.78	57.14	57.96		54	42.24	42.68	42.46
	60	60.66	57.08	58.87		60	41.83	43.25	42.54
	66	60.48	57.39	58.94		66	44.73	42.58	43.66
	72	60.1	57.79	58.95		72	45.33	43.46	44.40

Lanjutan Tabel

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (%)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (%)
		1	2				1	2	
20	0	36.14	36.47	36.31	30	0	36.44	37.27	36.86
	6	37.26	39.43	38.35		6	38.6	38.16	38.38
	12	41.40	42.43	41.92		12	37.53	39.08	38.31
	18	42.51	42.93	42.72		18	39.52	37.42	38.47
	24	45.23	43.84	44.54		24	40.38	38.3	39.34
	30	43.73	43.04	43.39		30	39.75	39.25	39.50
	36	44.12	43.34	43.73		36	40.4	40.98	40.69
	42	44.34	43.23	43.79		42	42.28	41.02	41.65
	48	45.68	43.57	44.63		48	43.99	40.53	42.26
	54	44.51	44.79	44.65		54	44.26	41.39	42.83
	60	44.76	43.04	43.90		60	42.75	43.22	42.99
	66	45.26	43.71	44.49		66	44.9	44.75	44.83
	72	44.48	44.23	44.36		72	44.48	43.36	43.92

Lampiran 5. Nilai rataan hubungan antara variasi konsentrasi substrat pati sagu dan lama sakarifikasi terhadap nilai dekstrosa ekuivalen (%)

Lama Sakarifikasi (jam)	Konsentrasi Substrat (%)				Rataan
	15	20	25	30	
0	35.97	36.31	36.12	36.86	**36.31**
6	44.13	38.35	37.81	38.38	**39.67**
12	48.43	41.92	38.43	38.31	**41.77**
18	53.10	42.72	38.22	38.47	**43.13**
24	57.24	44.54	39.68	39.34	**45.20**
30	56.65	43.39	40.51	39.50	**45.01**
36	56.84	43.73	39.56	40.69	**45.20**
42	56.30	43.79	42.04	41.65	**45.94**
48	58.35	44.63	42.18	42.26	**46.85**
54	57.96	44.65	42.46	42.83	**46.97**
60	58.87	43.90	42.54	42.99	**47.07**
66	58.94	44.49	43.66	44.83	**47.98**
72	58.95	44.36	44.40	43.92	**47.90**
Rataan	**53.98**	**42.83**	**40.58**	**40.77**	

Lampiran 6a. Analisa sidik ragam pengaruh variasi konsentrasi pati sagu (%) dan lama sakarifikasi (jam) terhadap dekstrosa ekuivalen (%) sirup glukosa

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9687.988[a]	51	189.961	86.987	.000
Intercept	408222.728	1	408222.728	186933.439	.000
Konsentrasi	6539.666	3	2179.889	998.215	.000*
Waktu	1967.116	12	163.926	75.065	.000*
Konsentrasi * Waktu	1181.206	36	32.811	15.025	.000*
Error	340.671	156	2.184		
Total	418251.387	208			
Corrected Total	10028.659	207			

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berperngaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 6b. Analisa lanjutan duncan pengaruh konsentrasi substrat terhadap dekstrosa ekuivalen (%)

Konsentrasi Substrat (%)	N	Subset		
		1	2	3
25%	52	40.5837		
30%	52	40.7812		
20%	52		42.8340	
15%	52			53.9765
Sig.		0.497	1.000	1.000

Lampiran 6c. Analisa lanjutan duncan pengaruh lama sakarifikasi terhadap dekstrosa ekuivalen (%)

Waktu Sakarifikasi (jam)	N	Subset						
		1	2	3	4	5	6	7
0 jam	16	36.3112						
6 jam	16		39.6663					
12 jam	16			41.7675				
18 jam	16			43.1381				
30 jam	16				45.0131			
36 jam	16				45.2013			
24 jam	16				45.2056			
42 jam	16				45.9481	45.9481		
48 jam	16						46.8581	46.8581
54 jam	16						46.9713	46.9713
60 jam	16						47.0744	47.0744
72 jam	16							47.9081
66 jam	16							47.9844
Sig.		1.000	1.000	0.106	0.386	1.000	0.517	0.136

Lampiran 6d. Analisa lanjutan duncan pengaruh interaksi konsentrasi substrat dan lama sakarifikasi terhadap dekstrosa ekuivalen (%)

Dekstrosa Equivalen															
Duncan[a,b]															
Perlakuan	N	Subset													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
S1T0	2	35.97													
S3T0	2	36.12													
S2T0	2	36.31													
S4T0	2	36.86	36.86												
S3T1	2	37.81	37.81	37.81											
S3T3	2	38.22	38.22	38.22	38.22										
S4T2	2	38.31	38.31	38.31	38.31										
S2T1	2	38.35	38.35	38.35	38.35										
S4T1	2	38.38	38.38	38.38	38.38										
S3T2	2	38.43	38.43	38.43	38.43										
S4T3	2	38.47	38.47	38.47	38.47										
S4T4	2		39.34	39.34	39.34	39.34									
S4T5	2		39.50	39.50	39.50	39.50	39.50								
S3T6	2		39.56	39.56	39.56	39.56	39.56								
S3T4	2		39.68	39.68	39.68	39.68	39.68	39.68							
S3T5	2			40.51	40.51	40.51	40.51	40.51	40.51						
S4T6	2				40.69	40.69	40.69	40.69	40.69	40.69					
S4T7	2					41.65	41.65	41.65	41.65	41.65	41.65				

S2T2	2					41.92	41.92	41.92	41.92	41.92	41.92	41.92			
S3T7	2					42.04	42.04	42.04	42.04	42.04	42.04	42.04			
S3T8	2						42.18	42.18	42.18	42.18	42.18	42.18			
S4T8	2						42.26	42.26	42.26	42.26	42.26	42.26			
S3T9	2							42.46	42.46	42.46	42.46	42.46			
S3T10	2								42.54	42.54	42.54	42.54			
S2T3	2								42.72	42.72	42.72	42.72			
S4T9	2								42.83	42.83	42.83	42.83			
S4T10	2								42.99	42.99	42.99	42.99			
S2T5	2									43.39	43.39	43.39			
S3T11	2										43.66	43.66			
S2T6	2										43.73	43.73			
S2T7	2										43.79	43.79			
S2T10	2										43.90	43.90			
S4T12	2										43.92	43.92			
S1T1	2										44.13	44.13			
S2T12	2										44.36	44.36			
S3T12	2										44.40	44.40			
S2T11	2										44.49	44.49			
S2T4	2										44.54	44.54			
S2T8	2											44.63			
S2T9	2											44.65			
S4T11	2											44.83			
S1T2	2												48.43		

S1T3	2													53.10	
S1T7	2														56.30
S1T5	2														56.65
S1T6	2														56.84
S1T4	2														57.24
S1T9	2														57.96
S1T8	2														58.35
S1T10	2														58.87
S1T11	2														58.94
S1T12	2														58.95
Sig.		0.085	0.053	0.065	0.090	0.060	0.056	0.052	0.089	0.065	0.054	0.053	1.000	1.000	0.064

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- T0 (0 jam), T1 (6 jam), T2 (12 jam), T3 (18 jam), T4 (24 jam), T5 (30 jam), T6 (36 jam), T7 (42 jam), T8 (48 jam), T9 (54 jam), T10 (60 jam), T11 (66 jam), dan T12 (72 jam)

Lampiran 7. Perolehan nilai Total padatan terlarut (ºBrix) sirup glukosa dengan variasi konsentrasi substrat pati sagu

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (Brix)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (Brix)
		1	2				1	2	
15	0	14.8	14.8	14.80	25	0	23.3	23.3	23.30
	6	15.10	15.1	15.10		6	23.8	23.8	23.80
	12	15.30	15.30	15.30		12	24.00	24	24.00
	18	15.1	15.1	15.10		18	24.00	24.2	24.10
	24	15.4	15.3	15.35		24	24	24.5	24.25
	30	15.4	15.4	15.40		30	24	24.4	24.20
	36	15.5	15.4	15.45		36	24	24.4	24.20
	42	15.5	15.3	15.40		42	24.6	24.6	24.60
	48	15.7	15.5	15.60		48	24.6	24.7	24.65
	54	15.7	15.5	15.60		54	24.7	24.7	24.70
	60	15.9	15.7	15.80		60	24.7	24.8	24.75
	66	16.1	15.6	15.85		66	24.7	24.8	24.75
	72	17.1	15.5	16.30		72	24.7	25.8	25.25

Lanjutan tabel

Suspensi (%)	Waktu (jam)	Ulangan		Rataan (Brix)	Suspensi (%)	Waktu (jam)	Ulangan		Rataan (Brix)
		1	2				1	2	
20	0	19.2	19.3	19.25	30	0	28.5	28.5	28.50
	6	19.5	19.7	19.60		6	28.7	28.7	28.70
	12	19.90	20.1	20.00		12	28.8	28.8	28.80
	18	19.90	20	19.95		18	28.7	28.7	28.70
	24	20.1	20.2	20.15		24	28.9	28.8	28.85
	30	20.2	20.2	20.20		30	28.9	28.8	28.85
	36	20.2	20.2	20.20		36	28.9	28.8	28.85
	42	20.3	20.3	20.30		42	28.8	28.8	28.80
	48	20.3	20.4	20.35		48	29.2	28.8	29.00
	54	20.3	20.3	20.30		54	29.6	28.8	29.20
	60	20.4	20.4	20.40		60	29.8	29.1	29.45
	66	20.4	20.6	20.50		66	29.8	29.6	29.70
	72	20.7	20.8	20.75		72	30.4	29.8	30.10

Lampiran 8. Nilai rataan hubungan antara variasi konsentrasi substrat pati sagu dan lama sakarifikasi terhadap Total padatan terlarut (ºBrix)

Lama Sakarifikasi (jam)	Konsentrasi Substrat (%)				Rataan
	15	20	25	30	
0	14.80	19.25	23.30	28.50	**21.46**
6	15.10	19.60	23.80	28.70	**21.80**
12	15.30	20.00	24.00	28.80	**22.03**
18	15.10	19.95	24.10	28.70	**21.96**
24	15.35	20.15	24.25	28.85	**22.15**
30	15.40	20.20	24.20	28.85	**22.16**
36	15.45	20.20	24.20	28.85	**22.18**
42	15.40	20.30	24.60	28.80	**22.28**
48	15.60	20.35	24.65	29.00	**22.40**
54	15.60	20.30	24.70	29.20	**22.45**
60	15.80	20.40	24.75	29.45	**22.60**
66	15.85	20.50	24.75	29.70	**22.70**
72	16.30	20.75	25.25	30.10	**23.10**
Rataan	**15.47**	**20.15**	**24.35**	**29.04**	

Lampiran 9a. Analisa sidik ragam pengaruh variasi konsentrasi pati sagu (%) dan lama sakarifikasi (jam) terhadap Total padatan terlarut (ºBrix) sirup glukosa

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5285.030[a]	51	103.628	2402.076	.000
Intercept	102981.900	1	102981.900	2387099.024	.000
Konsentrasi * Waktu	3.013	36	0.084	1.940	.003*
Konsentrasi	5248.579	3	1749.526	40553.657	.000*
Waktu	33.437	12	2.786	64.589	.000*

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berperngaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 9b. Analisa lanjutan Duncan pengaruh konsentrasi substrat terhadap Total padatan terlarut (ºBrix)

Konsentrasi Substrat (%)	N	Subset			
		1	2	3	4
15%	52	15.4654			
20%	52		20.1500		
25%	52			24.3500	
30%	52				29.0385
Sig.		1.000	1.000	1.000	1.000

Lampiran 9c. Analisa lanjutan Duncan pengaruh lama sakarifikasi terhadap Total padatan terlarut (ºBrix)

Waktu (jam)	N	Subset								
		1	2	3	4	5	6	7	8	9
0 jam	16	21.462								
6 jam	16		21.80							
18 jam	16			21.965						
12 jam	16			22.030	22.0300					
24 jam	16				22.1500	22.1500				
30 jam	16				22.1625	22.1625				
36 jam	16				22.1850	22.1850				
42 jam	16					22.2850	22.2850			
48 jam	16						22.4000	22.40		
54 jam	16							22.45		
60 jam	16								22.60	
66 jam	16								22.70	
72 jam	16									23.10
Sig.		1.000	1.000	0.396	0.063	0.123	0.091	0.497	0.175	1.000

Lampiran 9d. Analisa lanjutan Duncan pengaruh interaksi konsentrasi substrat dan lama sakarifikasi terhadap Total padatan terlarut (ºBrix)

Total padatan terlarut																			
Duncan[a,b]																			
Perlakuan	N	Subset																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
S1T0	2	14.80																	
S1T1	2	15.10	15.10																
S1T3	2	15.10	15.10																
S1T2	2	15.30	15.30	15.30															
S1T4	2	15.35	15.35	15.35															
S1T5	2		15.40	15.40															
S1T7	2		15.40	15.40															
S1T6	2		15.45	15.45															
S1T8	2		15.60	15.60															
S1T9	2		15.60	15.60															
S1T10	2			15.80	15.80														
S1T11	2			15.85	15.85														
S1T12	2				16.30														
S2T0	2					19.25													
S2T1	2					19.60	19.60												
S2T3	2						19.95	19.95											
S2T2	2						20.00	20.00											
S2T4	2						20.15	20.15											

S2T5	2							20.20	20.20										
S2T6	2							20.20	20.20										
S2T7	2							20.30	20.30										
S2T9	2							20.30	20.30										
S2T8	2							20.35	20.35										
S2T10	2							20.40	20.40										
S2T11	2							20.50	20.50										
S2T12	2								20.75										
S3T0	2									23.30									
S3T1	2									23.80	23.80								
S3T2	2										24.00								
S3T3	2										24.10	24.10							
S3T5	2										24.20	24.20	24.20						
S3T6	2										24.20	24.20	24.20						
S3T4	2										24.25	24.25	24.25						
S3T7	2											24.60	24.60						
S3T8	2											24.65	24.65						
S3T9	2												24.70	24.70					
S3T10	2												24.75	24.75					
S3T11	2												24.75	24.75					
S3T12	2													25.25					
S4T0	2														28.50				
S4T1	2														28.70	28.70			
S4T3	2														28.70	28.70			

S4T2	2														28.80	28.80			
S4T7	2														28.80	28.80			
S4T4	2														28.85	28.85			
S4T5	2														28.85	28.85			
S4T6	2														28.85	28.85			
S4T8	2														29.00	29.00	29.00		
S4T9	2															29.20	29.20	29.20	
S4T10	2																29.45	29.45	
S4T11	2																	29.70	29.70
S4T12	2																		30.10
Sig.		0.06	0.10	0.07	0.07	0.17	0.05	0.07	0.07	0.05	0.13	0.06	0.07	0.05	0.10	0.10	0.10	0.07	0.12

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- T0 (0 jam), T1 (6 jam), T2 (12 jam), T3 (18 jam), T4 (24 jam), T5 (30 jam), T6 (36 jam), T7 (42 jam), T8 (48 jam), T9 (54 jam), T10 (60 jam), T11 (66 jam), dan T12 (72 jam)

Tahap II. Pengaruh konsentrasi enzim amiloglukosidase (AMG) dan konsentrasi substrat pati sagu

Lampiran 10. perolehan nilai gula pereduksi (g/L) sirup glukosa dengan variasi konsentrasi enzim

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat (%)	Ulangan		Rerata
		1	2	
208	15	87.61	87.43	**87.52**
	20	91.36	87.13	**89.25**
	25	105.48	97.05	**101.27**
	30	131.96	121.59	**126.78**
260	15	102.06	97.89	**99.98**
	20	116.41	116.47	**116.44**
	25	143.72	136.33	**140.03**
	30	158.77	157.66	**158.22**
312	15	100.02	99.37	**99.70**
	20	120.24	122.3	**121.27**
	25	141.71	142.42	**142.07**
	30	157.44	161.51	**159.48**

Lampiran 11. Nilai rataan hubungan antara variasi konsentrasi enzim dan konsentrasi substrat terhadap nilai gula pereduksi (g/L)

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat				Rerata
	15	20	25	30	
208	87.52	89.25	101.27	126.78	**101.21**
260	99.98	116.44	140.03	158.22	**128.67**
312	99.7	121.27	142.07	159.48	**130.63**
Rerata	**95.73**	**108.99**	**127.79**	**148.16**	

Lampiran 12a. Analisa sidik ragam pengaruh konsentrasi enzim (U/kg) dan konsentrasi pati sagu (%) terhadap gula pereduksi (g/L) sirup glukosa

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	27960.005[a]	11	2541.819	232.395	.000
Intercept	697106.967	1	697106.967	63735.526	.000
Substrat * Enzim	884.948	6	147.491	13.485	.000*
Substrat	19036.022	3	6345.341	580.146	.000*
Enzim	8039.036	2	4019.518	367.499	.000*
Error	393.750	36	10.937		
Total	725460.722	48			
Corrected Total	28353.755	47			

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berperngaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 12b. Analisa lanjutan duncan pengaruh konsentrasi substrat terhadap gula pereduksi (g/L)

Konsentrasi Substrat (%)	N	Subset			
		1	2	3	4
15	12	95.7275			
20	12		108.9850		
25	12			127.7908	
30	12				148.1533
Sig.		1.000	1.000	1.000	1.000

Lampiran 12c. Analisa lanjutan duncan pengaruh konsentrasi enzim terhadap gula pereduksi (g/L)

Konsentrasi Enzim (U/kg)	N	Subset	
		1	2
208	16	101.2150	
260	16		128.6719
312	16		130.6381
Sig.		1.000	0.101

Lampiran 12d. Analisa lanjutan duncan pengaruh interaksi konsentrasi enzim dan konsentrasi substrat terhadap gula pereduksi (g/L)

Perlakuan	N	Subset					
		1	2	3	4	5	6
S1E1	2	87.5200					
S2E1	2	89.2450					
S1E3	2		99.6950				
S1E2	2		99.9750				
S3E1	2		101.2650				
S2E2	2			116.4400			
S2E3	2			121.2700	121.2700		
S4E1	2				126.7750		
S3E2	2					140.0250	
S3E3	2					142.0650	
S4E2	2						158.2150
S4E3	2						159.4750
Sig.		0.630	0.676	0.191	0.140	0.569	0.724

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- E1 (AMG 208 U/kg), E2 (AMG 260 U/kg), dan E3 (AMG 312 U/kg)

Lampiran 13. Perolehan nilai dekstrosa ekuivalen (%) sirup glukosa dengan variasi konsentrasi enzim

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat (%)	Ulangan		Rerata
		1	2	
208	15	58.41	58.28	**58.35**
	20	45.68	43.57	**44.63**
	25	42.19	42.17	**42.18**
	30	43.99	40.53	**42.26**
260	15	68.04	65.26	**66.65**
	20	58.21	58.23	**58.22**
	25	57.49	54.23	**55.86**
	30	52.92	52.55	**52.74**
312	15	66.68	66.25	**66.47**
	20	60.12	61.15	**60.64**
	25	56.68	56.97	**56.83**
	30	52.48	53.84	**53.16**

Lampiran 14. Nilai rataan hubungan antara variasi konsentrasi enzim dan konsentrasi substrat pati sagu terhadap nilai dekstrosa ekuivalen (%)

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat				Rerata
	15	20	25	30	
208	58.53	44.63	42.18	42.26	**46.90**
260	66.65	58.22	55.86	52.74	**58.37**
312	66.47	60.64	56.83	53.16	**59.28**
Rerata	**63.88**	**54.50**	**51.62**	**49.39**	

Lampiran 15a. Analisa sidik ragam pengaruh variasi konsentrasi enzim dan konsentrasi pati sagu (%) dekstrosa ekuivalen (%) sirup glukosa

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3069.715[a]	11	279.065	155.386	.000
Intercept	144371.784	1	144371.784	80387.792	.000
Substrat * Enzim	84.653	6	14.109	7.856	.000*
Substrat	1446.488	3	482.163	268.473	.000*
Enzim	1538.574	2	769.287	428.347	.000*
Error	64.654	36	1.796		
Total	147506.153	48			
Corrected Total	3134.369	47			

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berperngaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 15b. Analisa lanjutan duncan pengaruh konsentrasi substrat terhadap dekstrosa ekuivalen (%)

Konsentrasi Substrat	N	Subset			
		1	2	3	4
30	12	49.3850			
25	12		51.6242		
20	12			54.4925	
15	12				63.8800
Sig.		1.000	1.000	1.000	1.000

Lampiran 15c. Analisa lanjutan duncan pengaruh konsentrasi enzim terhadap dekstrosa ekuivalen (%)

Konsentrasi Enzim	N	Subset	
		1	2
208	16	46.9019	
260	16		58.3750
312	16		59.2819
Sig.		1.000	0.076

Lampiran 15d. Analisa lanjutan duncan pengaruh interaksi konsentrasi enzim dan konsentrasi substrat terhadap dekstrosa ekuivalen (%)

Perlakuan	N	Subset					
		1	2	3	4	5	6
S3E1	2	42.1800					
S4E1	2	42.2600					
S2E1	2	44.6250					
S4E2	2		52.7350				
S4E3	2		53.1600	53.1600			
S3E2	2			55.8600	55.8600		
S3E3	2				56.8250		
S2E2	2				58.2200	58.2200	
S1E1	2				58.3450	58.3450	
S2E3	2					60.6350	
S1E3	2						66.4650
S1E2	2						66.6500
Sig.		0.089	0.742	0.053	0.092	0.092	0.886

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- E1 (AMG 208 U/kg), E2 (AMG 260 U/kg), dan E3 (AMG 312 U/kg)

Lampiran 16. Perolehan nilai Total padatan terlarut (ºBrix) sirup glukosa dengan variasi konsentrasi enzim

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat (%)	Ulangan		Rerata
		1	2	
208	15	15.7	15.5	**15.60**
	20	20.35	20.35	**20.35**
	25	24.65	24.65	**24.65**
	30	29.2	28.8	**29.00**
260	15	16.6	16.7	**16.65**
	20	21.4	21.4	**21.40**
	25	25.55	25.55	**25.55**
	30	31.6	31.5	**31.55**
312	15	16.9	16.8	**16.85**
	20	21.8	21..8	**21.80**
	25	26	25.9	**25.95**
	30	32	31.95	**31.98**

Lampiran 17. Nilai rataan hubungan antara variasi konsentrasi enzim dan konsentrasi substrat pati sagu terhadap Total padatan terlarut (ºBrix)

Konsentrasi Enzim (U/kg)	Konsentrasi Substrat				Rerata
	15	20	25	30	
208	15.6	20.35	24.65	29	**22.40**
260	16.65	21.4	24.55	31.55	**23.54**
312	16.85	21.8	25.95	31.98	**24.15**
Rerata	**16.37**	**21.18**	**25.05**	**30.84**	

Lampiran 18a. Analisa sidik ragam pengaruh variasi konsentrasi enzim dan konsentrasi pati sagu (%) terhadap Total padatan terlarut (ºBrix) sirup glukosa

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1396.581[a]	11	126.962	16470.730	.000
Intercept	26381.252	1	26381.252	3422432.676	.000
Substrat	1364.229	3	454.743	58993.685	.000*
Enzim	27.161	2	13.581	1761.811	.000*
Substrat * Enzim	5.190	6	0.865	112.225	.000*
Error	0.277	36	0.008		
Total	27778.110	48			
Corrected Total	1396.858	47			

Keterangan: [tn]) Tidak Nyata *)Nyata
Jika sig<0.05 =berperngaruh nyata
Jika sig>0.05 =tidak berpengaruh nyata

Lampiran 18b. Analisa lanjutan duncan pengaruh konsentrasi substrat terhadap Total padatan terlarut (ºBrix)

Konsentrasi Substrat	N	Subset			
		1	2	3	4
15	12	16.3667			
20	12		21.1833		
25	12			25.0533	
30	12				30.8417
Sig.		1.000	1.000	1.000	1.000

Lampiran 18c. Analisa lanjutan duncan pengaruh konsentrasi enzim terhadap Total padatan terlarut (ºBrix)

Konsentrasi Enzim (U/kg)	N	Subset		
		1	2	3
208	16	22.4000		
260	16		23.5475	
312	16			24.1538
Sig.		1.000	1.000	1.000

Lampiran 18d. Analisa lanjutan duncan pengaruh interaksi konsentrasi enzim dan konsentrasi substrat terhadap Total padatan terlarut (ºBrix)

Perla-kuan	N	Subset										
		1	2	3	4	5	6	7	8	9	10	11
S1E1	2	15.60										
S1E2	2		16.65									
S1E3	2		16.85									
S2E1	2			20.35								
S2E2	2				21.40							
S2E3	2					21.80						
S3E1	2						24.65					
S3E2	2							25.55				
S3E3	2								25.95			
S4E1	2									29.00		
S4E2	2										31.55	
S4E3	2											31.98
Sig.		1.000	0.070	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Keterangan:

- S1 (Substrat 15%), S2 (Substrat 20%), S3 (Substrat 25%), dan S4 (Substrat 30%)
- E1 (AMG 208 U/kg), E2 (AMG 260 U/kg), dan E3 (AMG 312 U/kg)

Lampiran 19. Dokumentasi penelitian

1. Likuifikasi

2. Sakarifikasi (Tahap I)

3. Sampling tiap 6 jam

4. Sakarifikasi (Tahap II)

5. Persiapan pengukuran absorbansi

6. Pengukuran absorbansi dan Total padatan terlarut

CURRICULUM VITAE

A. Data Pribadi

1. Nama : Miftahuddin
2. Tempat, tanggal lahir : Rappang, 03 April 1999
3. Alamat : Salubarani, Kab. Tana toraja
4. Kewarganegaraan : Warga Negara Indonesia

B. Riwayat Pendidikan

1. Tamat SD tahun 2010 di MIN 2 Tana toraja
2. Tamat SMP tahun 2013 di MTS Rahmatul Asri
3. Tamat SLTA tahun 2016 di SMA Rahmatul Asri
4. Sarjana (S1) tahun 2021 di Universitas Hasanuddin
5. Magister (S2) tahun 2024 di Universitas Hasanuddin

C. Riwayat Organisasi

1. Keluarga Mahasiswa Kimia Fmipa Unhas
2. Keluarga Mahasiswa Fmipa Unhas
3. Komunitas Pemerhati Lingkungan OZONE Kimia Unhas

D. Karya ilmiah yang telah dipublikasikan

1. Miftahuddin, Laga, A., & Bastian, F. (2024). The use of immobilized enzyme in starch bioconversion: An update review. *BIO Web of Conferences*, *96*, Article 01028. https://doi.org/10.1051/bioconf/20249601028