

## DAFTAR PUSTAKA

- Afidah, N. B. A. 2018. Aktivitas Kitinase Bakteri *Micromonospora* sp. AR17 Pada Berbagai pH Medium dan Suhu Inkubasi. Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.
- Agrios, A. G., and P. Pichat. 2005. State of the art and perspectives on materials and applications of photocatalysis over TiO<sub>2</sub>. *Journal of Applied Electrochemistry*. 35(7-8): 655-663.
- Aida, F. M., S. Al-Nusarie, and S. Taghreed. 2014. Production, optimization, characterization and antifungal activity of chitinase produced by *Aspergillus terreus*. *African Journal of Biotechnology*. 13(14): 1567-1578.
- Akbar, R. S. 2017. Produksi, Purifikasi Parsial dan Aktivitas Kitinase dari *Bacillus cereus* SMG 1.1. Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.
- Akeed, Y., F. Atrash, and W. Naffaa. 2020. Partial purification and characterization of chitinase produced by *Bacillus licheniformis* B307. *Heliyon*. 6(5): e03858.
- Alasalvar, C., F. Shahidi, and P. Quantick. 2000. Food and health applications of marine nutraceuticals: a review. In Alasalvar, C., and Taylor, T. (eds.). *Seafoods-Quality, Technology and Nutraceutical Applications*. Springer, London.p. 175-187.
- Alexander, M. 1977. *Microbiology of other polysaccharides, Introduction to Soil Microbiology* 2nd edition. John Wiley and sons. New York.
- Alwi, M., L. Merdekawaty, dan U. Umrah. 2012. Identifikasi Actinomycetes yang Terdapat Pada Tanah di sekitar Danau Lindu Sulawesi Tengah. *Biocelebes*. 6(1): 1-10.
- Annamalai, N., M. V. Rajeswari, S. Vijayalakshmi, and T. Balasubramanian. 2011. Purification and characterization of chitinase from *Alcaligenes faecalis* AU02 by utilizing marine wastes and its antioxidant activity. *Annals of microbiology*. 61(4): 801-807.
- Apriani, L. 2008. Seleksi Bakteri Penghasil Enzim Kitinolitik Serta Pengujian Beberapa Variasi Suhu dan pH untuk Produksi Enzim. Fakultas Matematika dan Ilmu Pengetahuan Alam. Departemen Biologi. Universitas Indonesia. Skripsi.
- Arnold, L. D and Solomon. 1986. Manual of Influence of carbon and nitrogen sources on the growth and sporulation of *Bacillus thuringiensis* var *Galleriae* for biopesticide Production. *Chemical and Biochemical Engineering*. 17: 225-231.
- Asnani, A. 2019. Eksplorasi aktinomisetes di kawasan mangrove Segara Anakan. UNSOED Press. Purwokerto.

- Azam, M. S., E. J. Kim, H. S. Yang, and J. K. Kim. 2014. High antioxidant and DNA protection activities of N-acetylglucosamine (GlcNAc) and chitobiose produced by exolytic chitinase from *Bacillus cereus* EW5. *Springerplus*. 3(1): 354.
- Bastaman, S., dan H. Aprianita. 1990. Penelitian Limbah Udang sebagai Bahan Industri Khitin dan Khitosan. BBIHP. Bogor.
- Bradford, M. M. 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical biochemistry*. 72(1-2): 248-254.
- Brzezinska, M. S., and W. Donderski. 2001. Occurrence and activity of the chitinolytic bacteria of *Aeromonas* genus. *Polish Journal of Environmental Studies*. 10(1): 27-32.
- Brzezinska, M. S., U. Jankiewicz, A. Burkowska, and M. Walczak. 2013. Chitinolytic microorganisms and their possible application in environmental protection. *Current Microbiology*. 68 (1) : 71-81.
- Buckle, K. A., R. A. Edwards, G. H. Fleet, M. Wooton. 1987. Ilmu Pangan. Terjemahan Hari Purnomo. Universitas Indonesia Press. Jakarta.
- Budiani, A., D. A. Santoso, I. Susanti, S. Mawardi, dan Siswanto. 2004. Ekspresi  $\beta$ -1,3 Glukanase dan Kitinase pada Tanaman Kopi Arabika (*Coffea arabica* L.) Tahan dan Rentan Karat Daun. *Jurnal Menara Perkebunan*. 72 (2): 57-71.
- Chasanah, E., Y. N. Fawzya, A. Pratitis, dan T. Nurhayati. 2007. Penapisan bakteri penghasil enzim kitosanase yang berasosiasi dengan spons laut. *Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan*. 2(2): 161-169.
- Chauhan, M., and P. Singh. 2013. Production, optimization and characterization of chitinase enzyme by *Bacillus subtilis*. *Agriways*. 1: 5-11.
- Chen, J. K., C. R. Shen, and C. L. Liu. 2010. N-acetylglucosamine: Production and applications. *Marine drugs*. 8(9): 2493-2516.
- Chen, J. P. and M. S. Lee. 1994. Simultaneous production and partition of chitinase during growth of *Serratia marcescens* in an aqueous two-phase system. *Biotechnol. Tech*. 8(11):783-788.
- Dahiya, N., R. Tewari, and G. S. Hoondal. 2006. Biotechnological aspects of chitinolytic enzymes: a review. *Applied microbiology and biotechnology*. 71(6): 773-782.
- Dawson, R. M. C., D. C. Elliott, W. H. Elliott, and K. M. Jones. 1969. Data for Biochemical Research. Oxford University Press. New York and Oxford.
- Devi, C. S., V. M. Srinivasan, B. Archana, S. S. Roy, and S. J. Naine. 2015. Production and partial purification of antifungal chitinase from *Bacillus cereus* VITSD3. *Bioscience Journal*. 31(3): 960-968.

- Dewi, I. M. 2008. Isolasi Bakteri dan Uji Aktifitas Kitinase Termofilik Kasar dari Sumber Air Panas Tinggi Raja, Simalungun, Sumatera Utara. Sekolah Pascasarjana. Universitas Sumatera Utara. Tesis.
- Fadilah, D. S., S. R. Dwiningsih, dan D. S. Marifah. 2009. Pengaruh penambahan glukosa dan ekstrak yeast terhadap biodelignifikasi ampas batang aren. *Ekuilibrium*. 8(1): 29-33.
- Fadlilah, F. R., dan M. Shovitri. 2014. Potensi Isolat Bakteri *Bacillus* dalam Mendegradasi Plastik dengan Metode Kolom Winogradsky. *Jurnal Sains dan Seni ITS*. 3(2): E40-E43.
- Gacto, M., J. Vicente-Soler, J. Cansado, and T. G. Villa. 2000. Characterization of an extracellular enzyme system produced by *Micromonospora chalcea* with lytic activity on yeast cells. *Journal of applied microbiology*. 88(6): 961-967.
- Gohel, V., A. Singh, M. Vimal, P. Ashwini, and H. S. Chhatpar. 2006. Review. Bioprospecting and Antifungal Potential Chitinolytic Microorganisms. *African J. of Biotechnology*. 5 (2): 54-72.
- Grogan, G. 2009. Practical biotransformations: a beginner's guide. John Wiley & Sons. New Jersey.
- Haliza, W., dan M. Suhartono. 2012. Karakteristik Kitinase dari Mikrobial. Institut Pertanian Bogor. Bogor.
- Han, Y., B. Yang, F. Zhang, X. Miao, and Z. Li. 2009. Characterization of antifungal chitinase from marine *Streptomyces* sp. DA11 associated with South China Sea sponge *Craniella australiensis*. *Marine Biotechnology*, 11(1), 132.
- Handika, D. B. 2015. Isolasi dan Karakterisasi Bakteri Kitinolitik dari Instalasi Pengolahan Limbah Cair Industri Pembekuan Udang di PT Toxindo Prima Kabupaten Cilacap. Fakultas Pertanian. Universitas Gadjah Mada Yogyakarta. Skripsi.
- Hartanti. 2010. Isolasi dan Seleksi Bakteri Selulolitik Termofilik dari Kawah Air Panas Gunung Pancar, Bogor. FMIPA. Institut Pertanian Bogor. Skripsi.
- Herdyastuti, N., T. J. Raharjo, M. Mudasir, dan S. Matsjeh. 2009. Kitinase dan Mikroorganisme Kitinolitik: Isolasi, Karakterisasi, dan Manfaat. *Indonesian Journal of Chemistry*. 9: 37-47.
- Herdyastuti, N., T. J. Raharjo, M. Mudasir, dan S. Matsjeh. 2009. Kitin Dari Limbah Cangkang Udang Sebagai Media Untuk Bakteri Kitinolitik Yang Diisolasi Dari Lumpur Sawah (Chitin From Waste of Shrimp Crab as Growth Medium for Chitinolytic Microorganism, Isolated From the Field Mud). *Jurnal Manusia dan Lingkungan*. 16(2): 115-121.
- Hirsch, A. M., and M. Valdés. 2010. *Micromonospora*: An important microbe for biomedicine and potentially for biocontrol and biofuels. *Soil Biology and Biochemistry*. 42(4): 536-542.

- Hsu, S. C., and J. L. Lockwood. 1974. Powdered chitin agar as a selective medium for enumeration of actinomycetes in water and soil. *Applied microbiology*. 29(3): 422-426.
- Hunter-Cevera, J. C., M. E. Fonda, and A. Belt. 1986. Isolation of cultures. American Society for Microbiology. Washington, D.C. (USA).
- Ishida, Y., I. Imai, T. Miyagaki, dan H. Kadota. 1982. Growth and uptake kinetics of a facultatively oligotrophic bacterium at low nutrient concentrations. *Microbial ecology*. 8(1): 23-32.
- Jamialahmadi, K., J. Behravan, M. F. Najafi, M. T. Yazdi, A. R. Shahverdi, and M. A. Faramarzi. 2011. Enzymatic production of N-acetyl-D-glucosamine from chitin using crude enzyme preparation of *Aeromonas* sp. PTCC1691. *Biotechnology*. 10(3): 292-297.
- Janson, J. C., K. O. Eriksson, and L. Ryden. 1998. Protein Purification: Principles, High-Resolution Methods and Applications. John Wiley and Sons. New York.
- Jholapara, R. J., R. S. Mehta, A. M. Bhagwat, dan C. S. Sawant. 2013. Exploring and optimizing the potential of chitinase production by isolated *Bacillus* spp. *International Journal of Pharmacy and Pharmaceutical Sciences*. 5: 412-418.
- Kamil, Z., M. Rizk, M. Saleh, and S. Moustafa. 2007. Isolation and Identification of Rhizosphere Soil Chitinolytic Bacteria and their Potential in Antifungal Biocontrol. *Global Journal of Molecular Sciences*. 2(2): 57-66.
- Koolman, J., dan Roehm, K. H. 2005. Color Atlas Biochemistry Edisi 2. Thieme. Marburg.
- Kumar, A., D. Kumar, N. George, P. Sharma, N. Gupta. 2018. A process for complete biodegradation of shrimp waste by a novel marine isolate *Paenibacillus* sp. AD with simultaneous production of Chitinase and chitin oligosaccharides. *Int. J. Biol. Macromol*. 109: 263–272.
- Kusmiati, M. A. 2002. Aktivitas bakteriosin dari bakteri *Leuconostoc mesenteroides* Pba1 pada berbagai media. *Makara Kesehatan*. 6(1): 1-6.
- Leetanasaksakul, K., and A. Thamchaipenet. 2018. Potential anti-biofilm producing marine actinomycetes isolated from sea sediments in Thailand. *Agriculture and Natural Resources*. 52(3): 228-233.
- Lehninger, A. L. 1982. Principles of Biochemistry (Dasar-Dasar Biokimia, alih bahasa: N. Thenawidjaja). Edisi ke-1. Erlangga. Jakarta.
- Liang, T. W., Y. J. Chen, Y. H. Yen, and S. L. Wang. 2007. The antitumor activity of the hydrolysates of chitinous materials hydrolyzed by crude enzyme from *Bacillus amyloliquefaciens* V656. *Process Biochemistry*. 42(4): 527-534.
- Maggadani, B. P. 2012. Optimasi Produksi N-asetilglukosamin dari Kitin Menggunakan Kitinase Hasil Isolasi Bakteri. Universitas Indonesia. Disertasi Doktor.

- Manfaati, R. 2010. Kinetika dan variabel optimum fermentasi asam laktat dengan media campuran tepung tapioka dan limbah cair tahu oleh *Rhizopus oryzae*. Universitas Diponegoro. Disertasi Doktor.
- Masuda, S., K. Azuma, S. Kurozumi, M. Kiyose, T. Osaki, T. Tsuka, and Y. Okamoto. 2014. Anti-tumor properties of orally administered glucosamine and N-acetyl-D-glucosamine oligomers in a mouse model. *Carbohydrate polymers*. 111: 783-787.
- McCreath, K. J., and G. W. Gooday. 1992. A rapid and sensitive microassay for determination of chitinolytic activity. *Journal of Microbiological Methods*. 14(4): 229-237.
- Moran, L. A., K. G. Scrimgeour, H. R. Horton, dan J. D. Rawn. 1994. *Biochemistry*. Second edit, Practice Hall, Inc. Upper Saddle River.
- Muchtadi, D., dan S. K. Betty. 1980. *Petunjuk Praktek Mikrobiologi Hasil Pertanian 2*. Departemen Pertanian dan Kebudayaan. Jakarta.
- Muharni, M., dan H. Widjajanti. 2011. Skrining bakteri kitinolitik antagonis terhadap pertumbuhan Jamur Akar Putih (*Rigidoporus lignosus*) dari rizosfir tanaman karet. *Jurnal Penelitian Sains*. 14: 51-56.
- Mukherjee, G., and S. K. Sen. 2006. Purification, characterization, and antifungal activity of chitinase from *Streptomyces venezuelae* P10. *Current microbiology*. 53(4): 265-269.
- Murray, R. K., D. K. Granner, P. A. Mayes, dan V. W. Rodwell. 2003. *Biokimia harper* edisi 25. Penerbit Buku Kedokteran EGC. Jakarta.
- Narita, V., A. L. Arum, S. Isnaeni, dan N. Y. Fawzya. 2014. Analisis bioinformatika berbasis web untuk eksplorasi enzim kitosanase berdasarkan kemiripan sekuens. *Jurnal Al-Azhar Indonesia Seri Sains dan Teknologi*. 1(4): 197-203.
- Nawani, N. N., and B. P. Kapadnis. 2001. One-step Purification of Chitinase from *Serratia marcescens* NKI, a Soil Isolat. *Journal of Applied Microbiology*. 90: 803-808.
- Nawani, N. N., and B. P. Kapadnis. 2003. Chitin degrading potential of bacteria from extreme and moderate environment. *Indian Journal of Experimental Biology*. 41: 248-254.
- Nelson, D. L., and M. M. Cox. 2000. *Lehninger Principles of Biochemistry*. Worth Publishers. Nueva York.
- Ningrum, D. R. 2012. *Purifikasi Parsial dan Karakterisasi Enzim Kitinase dari Cairan Digestive Gland Achatina fulica*. Universitas Airlangga. Surabaya. Doctoral dissertation.
- Noviendri, D., Y. N. Fawzya, dan E. Chasanah. 2008. Karakteristik dan sifat kinetika enzim kitinase dari isolat bakteri T5a1 asal terasi. *Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan*. 3(2): 123-129.

- Nuniek, H., T. R. Joko, Mudasir, dan Sabirin. 2009. Kitinase dan mikroorganisme kitinolitik: Isolasi, karakterisasi, dan manfaatnya. *Indo. J. Chem.* 9(1):37-47.
- Nurkanto, A. 2007. Identifikasi Aktinomisetes tanah hutan pasca kebakaran Bukit Bangkirai Kalimantan Timur dan potensinya sebagai pendegradasi selulosa dan pelarut fosfat. *Biodiversitas.* 8(4): 314-319.
- Nurrohmayati, F. D. 2016. Variasi Etanol-Asetonitril pada Pemurnian N-asetilglukosamin hasil Degradasi Enzimatis Kitin Jenis Amorf. *UNESA Journal of Chemistry.* 5(3): 7-12.
- Okazaki, K., F. Kato, N. Watanabe, S. Yasuda, Y. Masui, S. Hayakawa. 1995. Purification and Properties of Two Chitinase from *Streptomyces* sp. J-13-3. *Biosci. Biotech. Biochem.* 59(8): 1586- 1587.
- Orinda, E., I. D. Puspita, M. P. Putra, U. Ustadi, dan I. Y. Lelana. 2015. Aktivitas Enzim Pendegradasi Kitin dari Isolat SDI23 Asal Petis serta Karakterisasi pH dan Suhu Aktivitas Enzim Hasil Purifikasi Parsial. *Jurnal Perikanan Universitas Gadjah Mada.* 17(2): 96-102.
- O'Riordan, A., M. L. McHale, J. Gallagher, and A. P. McHale. 1989. Chitinase production following co-immobilization of *Micromonospora chalybeata* with chitin in calcium alginate. *Biotechnology letters.* 11(10): 735-738.
- Orskov. 1923. Name and Taxonomic Classification. <http://www.marinespecies.org/aphia.php?p=taxdetails&id=559597>. Diakses tanggal 20 Maret 2020.
- Oxtoby, D. W., H. P. Gillis, and L. J. Butler. 2015. *Principles of Modern Chemistry.* Cengage Learning. Boston.
- Pakpahan, R. 2009. Isolasi Bakteri dan Uji Aktivitas Protease Termofilik dari Sumber Air Panas Sipoholon Tapanuli Utara Sumatera Utara. Sekolah Pascasarjana. Universitas Sumatera Utara. Tesis.
- Patantis, G., D. S. Zilda, Y. N. Fawzya, and E. Chasanah. 2020. Purification of chitosanase from *Stenotrophomonas maltophilia* KPU 2123 and *Micromonospora* sp. T5a1 for chitoooligosacharide production. In *IOP Conference Series: Earth and Environmental Science.* (Vol. 404, No. 1, p. 012078). IOP Publishing.
- Patel, A. K., R. R. Singhanian, and A. Pandey. 2017. Production, purification, and application of microbial enzymes. In *Biotechnology of Microbial Enzymes.* Academic Press. pp. 13-41.
- Patel, S., and A. Goyal. 2017. Chitin and chitinase: role in pathogenicity, allergenicity and health. *Int. J. Biol. Macromol.* 97: 331–338.
- Pelczar, M. J., dan E. C. S. Chan. 2005. *Dasar-dasar Mikrobiologi.* Edisi 1. Terjemahan dari *Elements of Microbiology*, oleh Ratna siri Hadioetomo. UI-Press. Jakarta.
- Peter, M. G. 2005. Chitin and chitosan from animal sources. *Polysaccharides and polyamides in the food industry: properties, production, and patents,* 115-208.



- Poernomo, A. T., dan D. A. Purwanto. 2003. Enzim Kitinase. Majalah Farmasi Airlangga. Jakarta. 3(3): 31-32.
- Poernomo. 2004. Kitinase dalam Pengendalian Hayati. Majalah Farmasi Airlangga. Jakarta. 4(2): 24-27.
- Pramesti, E. 2019. Optimasi Konsentrasi Koloidal Kitin dan Inokulum dalam Produksi Kitinase oleh *Streptomyces* sp. PB 2 Menggunakan Response Surface Methodology. Universitas Gadjah Mada. Disertasi Doktor.
- Prashanth, K. V. H., and R. N. Tharanathan. 2007. Chitin/chitosan: modifications and their unlimited application potential—an overview. Trends in Food Science and Technology. 18:117-131
- Pratiwi, R. S., T. E. Susanto, Y. A. K. Wardani, A. Susanto. 2015. Enzim Kitinase dan Aplikasi di Bidang Industri: Kajian Pustaka. Jurnal Pangan dan Agroindustri. 3(3): 878-887.
- Price, N. C., and L. Stevens. 1989. Fundamentals of Enzymology. Oxford University Press. Oxford.
- Purkan, P., A. Baktir, dan A. R. Sayyidah. 2016. Produksi enzim kitinase dari *Aspergillus niger* menggunakan limbah cangkang rajungan sebagai inducer. Jurnal Kimia Riset. 1(1): 34-41.
- Purkan, P., A. Baktir, dan S. Sumarsih. 2014. Eksplorasi bakteri kitinolitik dari sampah organik: Isolasi dan karakterisasi enzim kitinase. Molekul. 9(2): 128-135.
- Purwoko, T. 2007. Fisiologi Mikroba. Bumi Aksara. Jakarta.
- Putri, A. L., dan A. Nurkanto. 2017. Keragaman Aktinomisetes Asal Serasah, Sedimen, dan Tanah Pulau Enggano, Bengkulu. Berita Biologi. 15(3): 217-225.
- Ramírez-Coutiño, L., M. del Carmen Marín-Cervantes, S. Huerta, S. Revah, and K. Shirai. 2006. Enzymatic hydrolysis of chitin in the production of oligosaccharides using *Lecanicillium fungicola* chitinases. Process Biochemistry. 41(5): 1106-1110.
- Ray, L., A. N. Panda, S. R. Mishra, A. K. Pattanaik, T. K. Adhya, M. Suar, and V. Raina. 2019. Purification and characterization of an extracellular thermo-alkali stable, metal tolerant chitinase from *Streptomyces chilikensis* RC1830 isolated from a brackish water lake sediment. Biotechnology Reports. 21: e00311.
- Reissig, J. L., J. L. Strominger, and L. F. Leloir. 1955. A modified colorimetric method for the estimation of N-acetyl amino sugars. Journal of Biological Chemistry. 217(2): 959-966.
- Rochima, E. 2006. Pemurnian dan Karakterisasi Kitin Deasetilase Termotabil dari *Bacillus* Papandayan Asal Kawah Mojang, Jawa Barat. Makalah Seminar Nasional dan Kongres PA TPI. Jakarta. Hal: 193- 209.

- Sahai, A. S., and M. S. Manocha. 1993. Chitinases of fungi and plants: Their involvement in morphogenesis and host-parasite interaction. *FEMS Microbiol. Rev.* 11:317-338.
- Saputri, D. P., dan Ustadi. 2020. Immobilization of *Aeromonas bivalvium* PT 2 cells with alginate and measurement of chitinolytic activities. 3rd ISMFR. E3S Web of Conferences 147.
- Sari, B. W., N. B. Isnaini, I. D. Puspita, A. Husni, dan U. Ustadi. 2017. Bioformation of N-Acetylglucosamine from Shrimp Shell Chitin by *Serratia marcescens* PT-6 Cultured in Various pH and Temperature. *Jurnal Perikanan Universitas Gadjah Mada*. 19(1): 53-59.
- Sarwono, J. 2006. Metode Penelitian Kuantitatif dan Kualitatif. Graha Ilmu. Yogyakarta.
- Sashiwa, H., S. Fujishima, N. Yamano, N. Kawasaki, A. Nakayama, E. Muraki, and S. I. Aiba. 2002. Production of N-acetyl-D-glucosamine from  $\alpha$ -chitin by crude enzymes from *Aeromonas hydrophila* H-2330. *Carbohydrate Research*. 337(8): 761-763.
- Scopes, R. 1994. Protein Purification Principles and Practice 3rd Edition (Cantor CR ed). Springer-Verlag. New York. pp. 270-277.
- Singh, G., J. R. Sharma, and G. S. Hoondal. 2008. Chitinase production by *Serratia marcescens* GG5. *Turkish Journal of Biology*. 32(4): 231-236.
- Soeka, Y. S. 2015. Karakterisasi enzim kitinase dan identifikasi isolat aktinomisetes KRC 21. D berasal dari Kebun Raya Cibodas. In *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*. 1(4): 1156-1161.
- Soeka, Y. S., dan E. Triana. 2016. Pemanfaatan limbah kulit udang untuk menghasilkan enzim kitinase dari *Streptomyces macrosporeus* InaCC A454. *Jurnal Kimia Terapan Indonesia (Indonesian Journal of Applied Chemistry)*. 18(01): 91-101.
- Suryadi, Y., T. P. Priyatno, D. N. Susilowati, I. M. Samudra, N. Yudhistira, dan E. D. Purwakusumah. 2013. Isolasi dan karakterisasi kitinase asal *Bacillus cereus* 11 UJ. *Jurnal Biologi Indonesia*. 9(1): 51-62.
- Suryadi, Y., T. P. Priyatno, I. M. Samudra, D. N. Susilowati, N. Lawati, dan E. Kustaman. 2016. Pemurnian parsial dan karakterisasi kitinase asal jamur entomopatogen *Beauveria bassiana* isolat BB200109. *Jurnal AgroBiogen*. 9(2): 77-84.
- Suthindhiran, K. R., M. A. Jayasri, and K. Kannabiran. 2009.  $\alpha$ -glucosidase and  $\alpha$ -amylase inhibitory activity of *Micromonospora* sp. VITSDK3 (EU551238). *International Journal of Integrative Biology*. 6(3): 115-120.
- Suzuki, K., N. Sugawara, M. Suzuki, T. Uchiyama, F. Katouno, N. Nikaidou, and T. Watanabe. 2002. Chitinases A, B, and C1 of *Serratia marcescens* 2170 produced



by recombinant *Escherichia coli*: enzymatic properties and synergism on chitin degradation. *Bioscience, biotechnology, and biochemistry*. 66(5): 1075-1083.

- Synowiecki, J., and N. A. Al-Khateeb. 2003. Production, properties, and some new applications of chitin and its derivatives. *Critical Review in Food Science and Nutrition*. 43(2): 145-147.
- Tamimi, M., dan N. Herdyastuti. 2013. Analisis gugus fungsi dengan menggunakan spektroskopi FT-IR dari variasi kitin sebagai substrat kitinase bakteri *Pseudomonas* sp. TNH-54 analysis functional groups using FT-IR spectroscopy of chitin variation as *Pseudomonas* sp. TNH. *UNESA Journal of Chemistry*. 2(2): 47-51.
- Toharisman, A., and M. T. Suhartono. 2007. Partial Purification and Characterization of Chitin Deacetylase Produced By *Bacillus Thermoleovorans* LW-4-11. *Indonesian Institute of Sciences*. 1-10.
- Torchilin, V. P. 2012. *Immobilized Enzymes in Medicine*. Springer Science & Business Media. Berlin.
- Trudel, J., and A. Asselin. 1989. Detection of Chitinase Activity After Polyacrylamide Gel Electrophoresis. *Analytical biochemistry*. 178(2): 362-366.
- Tsujibo, H., N. Kondo, K. Tanaka, K. Miyamoto, N. Bao, and Y. Imamori. 1999. Molecular Analysis of The Gene Encoding a Novel Transglycosylative Enzyme from *Alteromonas* sp. Strain 0-7 & Its Physiological Role in The Chitinolytic System. *J. Bacteriol.* Vol 81: 5461-5466.
- Umemoto, N., K. Yuka, O. Takayuki, O. Takuo, N. Tomoyuki, S. Sakuda, T. Taira and T. Fukamizo. 2015. Crystal structures and inhibitor binding properties of plantclass V chitinases: the cycad enzyme exhibits unique structural and functional features. *The Plant Journal*. 82: 54-66.
- Vaidya, R., S. Roy, S. Macmil, S. Gandhi, P. Vyas, H. S. Chhatpar. 2003. Purification and Characterization of Chitinase from *Alcaligenes xylosoxydans*. *Biotechnology Letters*. 25: 715-717.
- Verena, S. 2008. Chitinases of filamentous fungi: a large group of diverse proteins with multiple physiological functions. *Fungal Biology Reviews*. 22(1): 36-42.
- Vogan, C. L., C. Costa-Ramos, and A. F. Rowley. 2002. Shell disease syndrome in the edible crab, *Cancer pagurus*—isolation, characterization and pathogenicity of chitinolytic bacteria. *Microbiology*. 148(3): 743-754.
- Volk, W. A., dan M. F. Wheeler. 1993. *Mikrobiologi dasar*. Erlangga. Jakarta.
- Waluyo, L. 2016. *Mikrobiologi Umum Edisi Revisi (Revisi)*. Revisi. Universitas Muhammadiyah Malang. Malang.
- Wang, S. L., T. W. Liang, and Y. H. Yen. 2011. Bioconversion of chitin-containing wastes for the production of enzymes and bioactive materials. *Carbohydrate Polymers*. 84(2): 732-742.



- Watanabe, T., R. Kanai, T. Kawase, T. Tanabe, M. Mitsutomi, M. Sakuda and K. Miyashita. 1999. Family 19 Chitinases of *Streptomyces* species: Characterization and Distribution. *Microbiol.* 145: 3353-3363.
- Webb, C., and B. Atkinson. 1992. The role of chemical engineering in biotechnology. *The Chemical Engineering Journal.* 50(1): B9-B16.
- Widhyastuti, N. 2010. Purifikasi N-Asetil-DGluksamin Hasil Sintesa Secara Enzimatis untuk Bahan Obat dan Pangan Fungsional. Laporan Akhir. Lembaga Ilmu Pengetahuan Indonesia.
- Wijaya, S. 2002. Isolasi kitinase dari *Sceloderma columnare* dan *Tricoderma Harzianum*. *Jurnal Ilmu Dasar.* 3: 30-35.
- Younes, I., and M. Rinaudo. 2015. Chitin and chitosan preparation from marine sources. Structure, properties and applications. *Marine drugs.* 13(3): 1133-1174.
- Yurnaliza. 2002. Senyawa Kitin dan Kajian Aktivitas enzim Mikrobial Pendegradasinya. FMIPA-USU. Medan.
- Zamani, A., and M. Taherzadeh. 2010. Production of low molecular weight chitosan by hot dilute sulfuric acid. *BioResources.* 5(3): 1554-1564.