REFERENCES

Abdeshanian, P., Samat, N., Hamid, A.A. and Yusoff, W.M.W. (2009). Utilization of palm kernel cake for production of β-mannanase by *Aspergillus niger* FTCC 5003 in solid state fermentation using an aereated column bioreactor. *J Microbiol Biotechnol*. 37:103–109.

Akino, T., Nakamura, N. and Horikoshi. K. (1988). Characterization of three β-mannanases of an alkalophilic *Bacillus* sp. *Agric Biol Chem*. 52:773–779.

Alam, N.H., Meier, R., Schneider, H., Sarker, S.A., Bardhan, P.K., Mahalanabis, D., *et al*. (2000). Partially hydrolyzed guar gum-supplemented oral rehydration solution in the treatment of acute diarrhea in children. *J Pediatr Gastr Nutr*. 31:503–507.

Al-Ghazzewi, F.H., Khanna, S., Tester, R.F. and Piggott, J. (2007). The potential use of hydrolysed konjac glucomannan as a prebiotic. *J Sci Food Agric*. 87:1758–1766.

Alloue, W.A.M., Destain, J., Amighi, K. and Thonart, P. (2007). Storage of *Yarrowia lipolytica* lipase after spray-drying in the presence of additives. *Process Biochem.* 42:1357-1361.

Andrade, C. T., Azero, E. G., Luciano, L. and Gonçalves, M. P. (1999). Solution properties of the galactomannans extracted from the seeds of *Caesalpinia pulcherrima* and *Cassia javanica*: comparison with locust bean gum. *Int J Biol Macromol*. 26:181-185.

Araki, T. (1983). Purification and characterization of an endo-β-mannanase from *Aeromonas* sp. F-25. *J Fac Agr Kyushu Univ*. 27:89–98.

Aziz, S.A., Ong, L.G.A., Hassan, M.A. and Karim, M.I.A. (2008). Production parameters optimization of mannanse production from *Aspergillus niger* FTCC 5003 using palm kernel cake as carbon source. *Asi J Biochem*. 3:297–307.

Belghith, H., Ellouz Chaabouni, S. and Gargouri, A. (2001). Stabilization of *Penicillium occitanis* cellulases by spray drying in presence of Maltodextrin. *Enzyme Microb. Technol*. 28:253-258.

Berlin, A., Gilkes, N., Kilburn, D., Bura, R., Markov, A., Skomarovsky, A., Okunev, O., Gusakov, A., Maximenko, V., Gregg, D., Sinitsyn, A. and Saddler, J. (2005). Evaluation of novel fungal cellulase preparations for ability to hydrolyze softwood substrates—evidence for the role of accessory enzymes. *Enzyme Microb Technol.* 37:175–184.

Berlin, A., Maximenko, V., Gilkes, N. and Saddler, J. (2007). Optimization of enzyme complexes for lignocellulose hydrolysis. *Biotechnol Bioeng*. 97:287–296.

Bettiol, J.L.P., Boutique, J.P., Gualco, L.M.P., Johnston, J.P. (2000). Nonaqueous liquid detergent compositions comprising a borate releasing compound and a mannanase. Patent EP1059351.

Bhoria, P., Singh, G. and Hoondal, G.S. (2009). Optimization of mannanase production from *Streptomyces* sp. PG-08-03 in submerged fermentation. *Bioresources* 4:1130–1138.

Blibech, M., Ghorbel, R.E., Fakhfakh, I., Ntarima, P., Piens, K., Bacha, A.B. and Chaabouni, S.E. (2010). Purification and characterization of a low molecular weight of β-mannanases from *Penicillium occitanis* Pol6. *App Biochem Biotechnol*. 160:1227–1240.

Bouzouita, N., Khaldi, A., Zgoulli, S., Chebil, L., Chekki, R., Chaabouni, M. M. and Thonart, P. (2007). The analysis of crude and purified locust bean gum: A comparison of samples from different carob tree populations in Tunisia. *Food Chem*. 101:1508-1515.

Bradford, M.M. (1976). A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal Biochem*. 72:248–255.

Cazzulo, J.J. and Vidal, M.C. (1972). Effect of monovalent cations on the malic enzyme from the extreme halophile, *Halobacterium cutirubrum*. *J. Bacteriol*. 109:437-439.

Chauhan, P.S., Puri, N., Sharma, P. and Gupta, N. (2012). Mannanases: microbial sources, production, properties and potential biotechnological applications. *Appl Microbiol Biotechnol.* 93:1817-1830.

Chen, X., Cao, Y., Ding, Y., Lu, W. and Li, D. (2007). Cloning, functional expression and characterization of *Aspergillus sulphureus* β-mannanase in *Pichia pastoris*. *J Biotechnol.* 128:452–461.

Chong, C.H., Zulkifli, I. and Blair, R. (2008). Effects of dietary inclusion of palm kernel cake and palm oil, and enzyme supplementation on performance of laying hens. *Asian-Austral J Anim Sci*. 21:1053–1058.

Deutscher, M.P., Ed. (1990). *Guide to Protein Purification*; Methods in Enzymology. 182. Academic Press, San Diego.

Dhawan, S. and Kaur, J. (2007). Microbial mannanases: an overview of production and applications. *Crit Rev Biotechnol*. 27:197–216.

Dominguez, K. and Ward, W.S. (2009). A novel nuclease activity that is activated by Ca^{2+} chelated to EGTA. *Syst Biol Reprod Med*. 55:193-199.

Emi, S., Fukumoto, J. and Yamamoto. T. (1972). Crystallization and some properties of mannanase. *Agric Biol Chem*. 36:991–1001.

Eneyskaya, E.V., Sundqvist, G., Golubev, A.M., Ibatullin, F.M., Ivanen, D.R., Shabalin, K.A., Brumer, H. and Kulminskaya, A.A. (2009). Transglycosylating and hydrolytic activities of the β-mannosidase from *Trichoderma reesei. Biochimie* 91:632–638.

Fan, Z., Werkman, J.R. and Yuan, L. (2009). Engineering of a multifunctional hemicellulose. *Biotechnol Lett*. 31:751–757.

FAO, 2011. FAOSTAT. Food and Agriculture Organization of the United Nations.

Fattah, A.A.F., Hashem, A.M., Ismail, A.M.S. and Refai, E.M.A. (2009). Purification and some properties of β-mannanase from *Aspergillus oryzae* NRRL 3448. *J App Sci Res.* 5:2067–2073.

Feng, Y., He, Z., Ong, S. L., Hu, J., Zhang, Z. and Ng, W.J. (2003). Optimization of agitation, aeration, and temperature conditions for maximum β-mannanase production. *Enzyme Microb Technol.* 32:282-289.

Fernandez, F., Hinton, M. and Van Gils, B. (2002). Dietary mannan-oligosaccharides and their effect on chicken faecal microflora in relation to *Salmonella enteritidis* colonization. *Avian Pathol*. 31:49–58.

Ferreira H.M. and Filho E.X.F. (2004). Purification and characterization of a β-mannanase from *Trichoderma harzianum* strain T4. *Carbohydr Polymer*. 55:401–409.

Fu, Y., Jeong, S., Kim, J., Callihan, J., Park, K., Pai, C., *et al*. (2003). Mannose-based fast dissolving tablets. Patent US20060134195A1.

Gírio, F.M., Fonseca, C., Carvalheiro, F., Duarte, L.C., Marques, S., and Bogel-Łukasik, R. (2010). Hemicelluloses for fuel ethanol: a review. *Bioresource Technol*. 101:4775-4800.

Gubitz, G.M. and Steiner, W. (1995). ACS Symposium Series. *Am. Chem. Soc.* 618:319–331.

Gubitz, G.M., Lischnig, T., Stebbing, D. and Saddler, J.N. (1997). Enzymatic removal of hemicellulose from dissolving pulps. *Biotechnol Lett.* 19:491–495.

Gübitz, G.M., M. Hayn. G. Urbanz and W. Steiner. (1996). Purification and properties of an acidic β-mannanase from *Sclerotium rolfsii*. *J Biotechnol*. 45:165-172.

Gutierrez, O., Zhang, C., Caldwell, D.J., Carey, J.B., Cartwright, A.L. and Bailey, C.A. (2008). Guar meal diets as an alternative approach to inducing molt and improving *Salmonella enteritidis* resistance in late-phase laying hens. *Poultry Sci*. 87:536–540.

Halstead, J.R., M.P. Fransen, R.Y. Eberhart, A.J. Gilbert and G.P. Hazlewood. (2000). α-galactosidase A from *Pseudomonas fluorescens* subsp. Cellulose: cloning, high level expression and its role in galactomannan hydrolysis. *FEMS Microbiol Lett*. 192:197-203.

He, X., Liu, N., Zhang, Z., Zhang, B. and Ma, Y. (2008). Inducible and constitutive expression of a novel thermostable alkaline β-mannanase from alkalophilic *Bacillus* sp. N16-5 in *Pichia pastoris* and characterization of the recombinant enzyme. *Enzyme Microb Technol.* 43:13–18.

Heikkila, H. (1986). Production of pure sugars and lignosulfonates from sulfite spent liquor. Patent US4631129.

Hossain, M., J. Abe and S. Hizukuri. (1996). Multiples forms of β-mannanases from *Bacillus* sp. KK01. *Enzyme Microbial Technol.* 18:95-98.

Hubbard, J.S. and Miller, A.B. (1969). Purification and reversible inactivation of the isocitrate dehydrogenase from an obligate halophile. *J. Bacteriol*. 99:161-168.

Iyer, P. V., & Ananthanarayan, L. (2008). Enzyme stability and stabilization—aqueous and non-aqueous environment. *Process Biochem.* 43:1019-1032.

Jiang Z., Wei Y., Li D., Li L., Chai P. and Kusakabe I. (2006). High-level production, purification and characterization of a thermostable β-mannanases from the newly isolated *Bacillus subtilis* WY34. *Carbohydr Polymer*. 66:88–96.

Jorgensen, H., Sanadi, A.R., Felby, C., Lange, N.E.K., Fischer, M. and Ernst, S. (2010). Production of ethanol and feed by high dry matter hydrolysis and fermentation of palm kernel press cake. *Appl Biochem Biotechnol*. 161:318–332.

Khanongnuch, C., Asada, K., Tsuruga, H., Ooi, T., Kinoshita, S. and Lumyong, S. (1998). β-mannanase and xylanase of *Bacillus subtilis* 5H active for bleaching of crude pulp. *J Fermentation Bioeng.* 86:461-466.

Khanongnuch, C., Sa-nguansook, C. and Lumyong, S. (2006). Nutritive quality of β-mannanase treated copra meal in broiler diets and effectiveness on some fecal bacteria. *Int J Poult Sci*. 5:1087-1091.

Kim, S.W., Zhang, J.H., Soltwedel, K.T. and Knabe, D.A. (2006). Use of carbohydrases in corn-soybean meal based grower-finisher pig diets. *Anim Res*. 55:563–578.

Kote, N.V., Patil, A.G.G. and Mulimani, V.H. (2009). Optimization of the production of thermostable endo-β-1,4 mannanase from a newly isolated *Aspergillus niger gr* and *Aspergillus flavus gr*. *Appl Biochem Biotechnol*. 152:213–223.

Kumao, T., Fujii, S., Asakawa, A., Takehara, I. and Fukuhara, I. (2006). Effect of coffee drink containing mannooligosaccharides on total amount of excreted fat in healthy adults. *J Health Sci*. 52:482–485.

Laemmli, U. K. (1970). Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature (London).* 227:680–685.

Lian, W.C., Hsiao, H.C. and Chou, C.C. (2002). Survival of bifidobacteria after spray-drying. *Int J Food Microbiol.* 74:79-86.

Lin, S.S., Dou, W.F., Xu, H., Li, H.Z., Xu, Z.H. and Ma, Y. (2007). Optimization of medium composition for the production of alkaline β-mannanase by alkaliphilic *Bacillus* sp. N16-5 using response surface methodology. *Appl Microbiol Biotechnol.* 75:1015–1022.

Lin, T. C. and C. Chen. (2004). Enhanced mannanase production by submerged culture of *Aspergillus niger* NCH-189 using defatted copra meal based media. *Process Biochem.* 39:1103-1109.

Lundqvist, J., Teleman, A., Junel, L., Zacchi, G., Dahlman, O., Tjerneld, F., and Stålbrand, H. (2002). Isolation and characterization of galactoglucomannan from spruce (*Picea abies*). *Carbohydrate Polymers* 48:29-39.

Ma, Y., Xue, Y., Dou, Y., Xu, Z., Tao, W. and Zhou, P. (2004). Characterization and gene cloning of a novel beta-mannanase from alkalophilic *Bacillus* sp. N16-5. *Extremophiles* 8:447–454.

Mabrouk, M.E.M. and Ahwany, A.M.D.E.I. (2008). Production of β-mannanase by *Bacillus amyloliquefaciens* 10A1 cultured on potato peels. *Afri J Biotechnol*. 7:1123–1128.

Matheson, N.K. (1990). Mannose-based polysaccharides. *Met in Plant Biochem*. 2:371–413.

McCleary, B.V. (1979). Modes of action of β-mannanase enzymes of diverse origin on legume seed galactomannans. *Phytochemistry* 18:757-763.

Meenakshi, Singh G., Bhalla A. and Hoondal G.S. (2010). Solid state fermentation and characterization of partially purified thermostable mannanase from *Bacillus* sp. MG-33. *Bioresources* 5:1689–1701.

Mendoza N.S., Arai M., Kawaguchi T., Yoshida T. and Joson L.M. (1994). Purification and properties of mannanase from *Bacillus subtilis*. *World J Microbiol Biotechnol.* 10:551–555.

Miller, G. L. (1959). Use of Dinitrosalicylic acid reagent for determination of reducing sugar. *Anal Chem.* 31:426–428.

Mohamad, S.N., Ramanan, R.N., Mohamad, R. and Ariff, A.B. (2011). Improved mannan degrading enzymes production by *Aspergillus niger* through medium optimization. *New Biotechnol*. 28:146–152.

Moreira, L.R.S. (2008). An overview of mannan structure and mannan degrading enzyme systems. *Appl Microbiol Biotechnol.* 79:165–78.

Moreira, L.R.S. and Filho, E.X.F. (2008). An overview of mannan structure and mannan degrading enzyme systems. *Appl Microbiol Biotechnol*. 79:165–178.

Mou H., Zhou F., Jiang X. and Liu Z. (2011). Production, purification and properties of β-mannanase from soil bacterium *Bacillus circulans* M-21. *J Food Biochem*. 35:1451–1460.

Mullin, W.J. and Xu, W. (2001) Study of soybean seed coat components and their relationship to water absorption. *J Agric Food Chem*. 49:5331–5335.

Nicolas, P., Raetz, E., Reymond, S. and Sauvegeat, J.L. (1998). Hydrolysis of the galactomannans of coffee extract with immobilized β-mannanase. Patent US5714183.

Nunes, F.M., Reis, A,. Domingues, M.R. and Coimbra, M.A. (2006). Characterization of galactomannan derivatives in roasted coffee beverages. *J Agric Food Chem*. 54:3428–3439.

Oda, Y., Komaki, T. and Tonomura. K. (1993). Purification and properties of extracellular β-mannanases produced by *Enterococcus casseliflavus* FL2121 isolated from decayed konjac. *J Ferment Bioengin*. 76:14–18.

Parisi, G.C., Zilli, M., Miani, M.P., Carrara, M., Bottona, E., Verdianelli, G., *et al*. (2002). Highfiber diet supplementation in patients with Irritable Bowel Syndrome (IBS): A multicenter, randomized, open trial comparison between wheat bran diet and partially hydrolyzed guar gum (PHGG). *Digest Dis Sci*. 47:1697–1704.

Puls, J., and Schuseil, J. (1993). Chemistry of hemicellulose: relationship between hemicellulose structure and enzyme required for hydrolysis. In: Coughlan MP, Hazlewood GP (eds) Hemicellulose and Hemicellulases. Portland, London. 1–27.

Regalado, C., García-Almendárez, B.E., Venegas-Barrera, L.M., Téllez-Jurado, A., Rodríguez-Serrano, G., Huerta-Ochoa, S. and Whitaker, J.R. (2000). Production, partial purification and properties of β-mannanases obtained by solid substrate fermentation of spent soluble coffee wastes and copra paste using *Aspergillus oryzae* and *Aspergillus niger*. *J Sci Food Agr*. 80:1343-1350.

Sa-nguansook, C. (2002). Quality improvement of coconut meal by enzyme for application in feed production. M.S. Thesis. Chiang Mai University**.**

Scheller, H.V. and Ulvskov, P. (2010). Hemicelluloses. *Annu Rev Plant Biol*. 61:263–89.

Schroder, R., Atkinson, R.G. and Redgwell, R.J. (2009). Re-interpreting the role of endo-β-mannanases as mannan endotransglycosylase/hydrolases in the plant cell wall. *Ann Bot*. 104:197–204.

Selivanov, A.S. (2005). Stabilization of cellulases using spray drying. *Eng Life Sci*. 5:78-80.

Singh, G., Bhalla, A. and Hoondal, G.S. (2010). Solid state fermentation and characterization of partially purified thermostable mannanase from *Bacillus* sp. MG-33. *Bioresources* 5:1689–1701.

Sundu, B., Kumar, A. and Dingle, J. (2006). Response of broiler chicks fed increasing levels of copra meal and enzymes. *Int J Poult Sci*. 5:13-18.

Sundu, B., Kumar, A. and Dingle, J. (2009). Feeding value of copra meal for broilers. *World Poultry Sci J*. 65:481-492.

Takahashi, R., Kusakabe, I. Kobayashi, H. Murakami, K. Maekawa, A. and Suzuki. T. (1984). Purification and some properties of mannanase from *Streptomyces* sp. *Agric Biol Chem*. 48:2189–2195.

Titapoka, S., Keawsompong, S., Haltrich, D. and Nitisinprasert, S. (2008). Selection and characterization of mannanase producing bacteria useful for the formation of prebiotic mannooligosaccharides from copra meal. *World J Microbiol Biotechnol.* 24:1425–1433.

Upathanpreecha, T. (2003). Study of thermostable phytase from actinomycetes for application in animal feed. M.S. Thesis. Chiang Mai University**.**

Urairuj, C. (2003). Screening, purification and characterization of lignin degradation enzyme from endophytic *Xylaria* spp. M.S. Thesis. Chiang Mai University**.**

Van Zyl, W.H., Rose, S.H., Trollope, K. and Gorgens, J.F. (2010). Fungal β-mannanases: mannan hydrolysis, heterologous production and biotechnological applications. *Pro Biochem*. 45:203–1213.

Wang, M., You, S., Zhang, S., Qi, W., Liu, Z., Wu, W., Su R. and He, Z. (2013). Purification, characterization, and production of β-mannanase from *Bacillus subtilis* TJ-102 and its application in gluco-mannooligosaccharides preparation. *Eur Food Res Technol*. 237:399-408.

Wongputtisin, P., Khanongnuch, C., Khongbantad, W., Niamsup, P. and Lumyong, S. (2012). Screening and selection of *Bacillus* spp. for fermented corticate soybean meal production. *J Appl Microbiol*. 113:798-806.

Wu, G., Bryant, M.M., Voitle, R.A. and Roland, S. (2005). Effects of β-mannanase in corn-soy diets on commercial leghorns in second-cycle hens. *Poultry Sci*. 84:894–897.

Yamabhai, M., Sak-Ubol, S., Srila, W. and Haltrich, D. (2014). Mannan biotechnology: from biofuels to health. *Critical Rev Biotechnol*. 1-11.

Yamaura, I., Matsumoto, T. Funatsu, M. and Funatsu. Y. (1990). Purification and some properties of endo-1,4-β-D-mannanase from *Pseudomonas* sp. PT-5. *Agric Biol Chem*. 54:2425–2427.

Yeh, S.L., Lin, M.S. and Chen, H.L. (2009). Partial hydrolysis enhances the inhibitory effects of konjac glucomannan from *Amorphophallus konjac* C. Koch on DNA damage induced by fecal water in Caco-2 cells. *Food Chem*. 119:614–618.

Yin, L.J., Tai, H.M. and Jiang, S.T. (2012). Characterization of mannanase from a novel mannanase-producing bacterium. *J Agric Food Chem*. 60:6425-6431.

Yokomizo F. (2009). Mannose-containing palm kernel meal. Patent US20040151804A1.

Zakaria M.M., Yamamoto S. and Yagi T. (1998). Purification and characterization of an endo-1,4-β-mannanase from *Bacillus subtilis* KU-1. *FEMS Microbiol Lett*. 158:25–31.

Zhang, M., Chen, X.L., Zhang, Z.H., Sun, C.Y., Chen, L.L., He, H.L., Zhou, B.C. and Zhang, Y.Z. (2009). Purification and functional characterization of endo-β-mannanase MAN5 and its application in oligosaccharides production from konjac flour. *Appl Microbiol Biotechnol*. 83:865–873.