

**DAFTAR PUSTAKA**

- Aghdam, M. S., Zisheng, L., Abbasali, J., Morteza, S., Yavar, S., Boukaga, F., Javad, R.F., dan Farhang, R. 2019. Employing exogenous melatonin applying confers chilling tolerance in tomato fruits by upregulating ZAT2/6/12 giving rise to promoting endogenous polyamines, proline, and nitric oxide accumulation by triggering arginine pathway activity. *Food Chemistry*, 275: 549–556.
- Astika, W. 1991. Penyingkatan daur pemuliaan dan analisis stabilitas hasil tanaman teh (*Camellia sinensis* L.). Disertasi Pascasarjana Universitas Padjadjaran, Bandung.
- Bai, Q., Yun, H., dan Yuanyue, S. 2021. The physiological and molecular mechanism of abscisic acid in regulation of fleshy fruit. *Front. Plant Sci.*, 11:619953. doi: 10.3389/fpls.2020.619953.
- Barry, C.S., dan James, J.G. 2007. Ethylene and fruit ripening. *J. Plant Growth Regul.*, 26: 143-159.
- Billy, L., Mehinagic, E., Royer, G., Renard, C.M.G.C., Arvisenet, G., Prost, C., dan Jourjon, F. 2008. Relationship between texture and pectin composition of two apple cultivars during storage. *Postharvest Biology and Technology*. 47: 315-324. Doi: 10.1016/j.postharvbio.2007.07.011.
- Blazek, J., Opatova, H., Golias, J., dan Homutova, I. 2007. Ideotype of apple with resistance to storage diseases. *Horticultural Science*, 34: 108-114. DOI: 10.17221/1890-HORTSCI.
- Bleecker, A.B., dan Kende, H. 2000. Ethylene: A gaseous signal molecule in plants. *Annu Rev Cell Dev Biol* 16:1-18.
- Blumenkrantz, N., dan Asboe-Hansen, G. 1973. New method for quantitative determination of uronic acids. *Analytical Biochemistry*, 54: 484-489. [https://doi.org/10.1016/0003-2697\(73\)90377-1](https://doi.org/10.1016/0003-2697(73)90377-1).
- Brookfield, P., Murphy, P., Harker, R., dan MacRae, E. 1997. Starch degradation and starch pattern indices: interpretation and relationship to maturity. *Postharvest Biology and Technology*, 11: 23-30.
- Brummell, D.A dan Harpster, M.H. 2001. Cell wall metabolism in fruit softening and quality and its manipulation in transgenic plants. *Plant. Mol. Biol.*, 47:311-339.
- Brummel, D.A., Cin, V.D., Lurie, S., Cristoto, C.H., dan Labavitch, J.M. 2004. Cell wall metabolism during the development of chilling injury in cold-storage peach fruit: association on mealiness with arrested disassembly of cell wall pectins. *Journal of Experimental Botany*, 55: 2041-2052. [Https://doi.org/10.1093/jxb/erh228](https://doi.org/10.1093/jxb/erh228).
- Brummel, D.A. 2006. Cell wall disassembly in ripening fruit. *Functional Plant Biology*, 22:103-119.
- CABI. 2012. Datasheet of *Malus domestica* (Apple). <https://www.cabi.org/isc/datasheet/31964>. Diakses pada 3 Januari 2021.
- Chrispeels, M.J., Nigel, M.C., dan Julian, I.S. 1999. Proteins for transport of water and mineral nutrients across the membranes of plant cells. *The Plant Cell*, 11: 661-675.



- Annual IDFTA Conference.
- Dubois, M., Gilles, KA. Hamilton, J.K., Rebers, P.A., dan Smith, F. 1956. Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28: 350-356. <https://doi.org/10.1021/ac60111a017>.
- Ezura, H. dan Hiwasa-Tanase, K., 2010. Fruit development, in: Pua, E.C., Davey, M.R., (Eds), Plant development biology- biotechnological perspectives. Vol. 1. Springer-Verlag, Berlin, Heidelberg, pp. 301-318.
- Fry, S.C. 2017. Ripening: Encyclopedia of applied plant science, 2nd Edition. The University of Edinburgh. United Kingdom: 323-334.
- Galmarini, M.V., Symoneaux, R., Chollet, S., dan Zamora, M.C. 2013. Understanding apple consumers expectations in terms of likes and dislikes. Use of comment analysis in a cross-cultural study. Appetite, 62: 27-36.
- Giovannoni, J. 2004. Genetic regulation of fruit development and ripening. Plant Cell, 16:170- 180.
- Gogtay, N.J dan Thatte, U. M. 2017. Principles of correlation analysis. Journal of the Association of Physicians of India, 55: 78-81.
- Gunes, G., Hotchkiss, J.H., dan Watkins, C.B. 2001. Effect of gamma irradiation on the texture of minimally processed apple slices. Journal of Food Science, 66: 63-67. <Https://doi.org/10.1111/j.1365-2621.2001.tb15582.x>.
- Gupta, P.K., Shreya, S.R., Deepali, V.P., Priyadharsiini, V., Vidya, S., Candrananthi, C., Shreya, C., Krithika, S., dan Keerthana, G. 2019. An update on overview of cellulose, its structure and applications. Intake: 1-23.
- Gwanpua, G.S., Buggenhout, S.V., Verlinden, B.E., Christiaens, S., Shpigelman, A., Vicent, V., Kermani, Z.J., Nicolai, B.M., Hendrickx, M., dan Geeraerd, A. 2014. Pectin modifications and the role of pectin-degrading enzyme during postharvest softening of Jonagold apples. Food Chemistry, 158: 283-291. DOI: 10.1016/j.foodchem.2014.02.138
- Harker F.R. dan Hallet, I.C., 1992. Physiological changes associated with development of mealiness of apple fruit during cool storage. Hort Science, 27: 1291-1294. <Https://doi.org/10.21273/HORTSCI.27.12.1291>.
- Harker, F.R., Redgwell, R.J., Hallett, I.C., Murray, S.H., dan Carter, G. 2010. Texture of fresh fruit. Horticultural Reviews, 20: 121–224.
- Harholt, J., Anongpat, S., dan Henrik, V.S. 2010. Biosynthesis of pectin. Plant Physiol, 153: 385-395.
- Hiwasa, K., Nakano, R., Hashimoto, A., Matsuzaki, M., Murayama, H., Inaba, A., dan Kubo, Y. 2004. European, Chinese and Japanese pear fruits exhibit differential softening characteristics during ripening. Journal of Experimental Botany, 55: 2281-2290. DOI: 10.1093/jxb/erh250.
- Honda, C., Hideo, B., Mari, M., Hiroshi, I., Shigeki, M., Kazuyuki, A., Masato, W., Yuki, M., Hiroko, H., dan Miho, T. 2014. Effect of temperature on anthocyanin synthesis and ethylene production in the fruit of early- and medium-maturing apple cultivars during ripening stages, 49:1510-1517.
- Hussain, P.R., Meena, R.S., Dar, M.A., dan Wani, A.M. 2012. Effect of post-harvest calcium chloride dip treatment and gamma irradiation on storage quality and shelf-life extension of red delicious apple. Journal Food Science and Technology, 49: 415- 426. doi: 10.1007/s13197-011-0289-0.



- AYU NURLAILA INDAH, Rani Agustina Wulandari, S.P., M.P., Ph.D; Panjisakti Basunanda, S.P., M.P.
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Iwananami, H., Moriyama, S., Kotoda, N., Takemoto, S., dan Abe, K. 2005. Influence of mealiness on the firmness of apples after harvest. Hort Science, 40: 2091-2095. <https://doi.org/10.21273/HORTSCI.40.7.2091>.
- Jackson, J.E. 2003. Biology of apple and pears. Cambridge University Press, Cambridge, UK.
- Jaeger, S.R., Andani, Z., Wakeling, I.N., dan MacFie, H.J.H. 1998. Consumer preferences for fresh and aged apples: A cross-cultural comparison. Food Qual. Prefer., 9(5):355-366.
- Jahan, S., Gosh, T., Begum, M., dan Saha, B. 2011. Nutritional profile of some tropical fruits in Bangladesh: specially antioxidant, vitamins and minerals. Bangladesh Journal of Medical, 10 (2): 96-103.
- Janssen, B.J., Kate, T., Robert, J.S., Rob, A., Lena, B., Rebecca, B., Judith, H.B., Ross, N.C., Andrew, P.G., Susan, L., Steve, M., Franch, B.P., Kimberley, C.S., dan Syaina, W. 2008. Global gene expression analysis of apple fruit development from the floral bud to ripe fruit. BMC Plant Biology, 8(16):1-29
- Johnston, J.W., Hewett, E.W. dan Hertog, T.M. 2002. Postharvest softening of apple (*Malus domestica*) fruit: a review. New Zealand J. Crop Hort. Sci., 30: 145-160.
- Jovyn, K.T., Roswita, S., Paul, W.S., Ian, C.H., Miriam, I.H., Roneel, P., Bronwen, G.S., Laurence, D.M., dan Jason, W.S. 2013. Cell wall structures leading to cultivar differences in softening rates develop early during apple (*Malus x domestica*) fruit growth. Plant Biology, 1: 1-16.
- Lakso, A.N., dan Martin, C.G. 2013. Apple fruit growth. New York Fruit Quarterly, 21 (1):1-4.
- Lampugnani, E.R., Ghazanfar, A.K., Marc, S., dan Staffan, P. 2018. Building a plant cell wall at a glance. Journal of Cell science, 131:1-6.
- Lin, Z., Silin, Z., dan Don, G. 2009. Recent advances in ethylene research. Journal of Experimental Botany, 60 (12): 3311-3336.
- Liu, B. H. 1998. Statistical genomics: linkage, mapping, and QTL analysis. Washington: CRC Pr. 611p.
- Lohani, S., Trivedi, P.K., dan Nath, P. 2004. Changes in activities of cell wall hydrolases during ethylene-induced ripening in banana effect of 1-MCP, ABA and IAA. Postharvest Biol. Technol., 31: 119-126.
- Longhi, S., Hamblin, M.T., Trainotti, L., Peace, C.P., Velasco, R., dan Costa, F. 2013. A candidate gene-based approach validates Md-PG1 as the main responsible for a QTL impacting fruit texture in apple (*Malus x domestica* Borkh.). BMC Plant Biology, 13: 1-13. DOI: 10.1186/1471-2229-13-37.
- Lurie, S., dan Crisosto, C.H. 2005. Chilling injury in peach and nectarine. Postharvest Biology and Technology, 37: 195-208. [Https://doi.org/10.1016/j.postharvbio.2005.04.012](https://doi.org/10.1016/j.postharvbio.2005.04.012).
- Manrique, G.D., dan Lajolo, F.M. 2004. Cell-wall polysaccharide modifications during postharvest ripening of papaya fruit (*Carica papaya*). Postharvest Biology and Technology, 33: 11-26. DOI: 10.1016/j.postharvbio.2004.01.007.
- Mikshina, P.V., Petrova, A.A., dan Gorshkova, T.A. 2015. Functional diversity of rhamnogalacturonans I. Russian Chemical Bulletin, International edition, 64 (5): 1014-1023.



STUDI KARAKTER FISIOLOGI SEBAGAI PENDEKATAN DAN PERTIMBANGAN UNTUK USAHA PEMULIAAN TANAMAN BUAH APEL
(*Malus sp.*)

- AYU NURLAILA INDAH, Rani Agustina Wulandari, S.P., M.P., Ph.D; Panjisakti Basunanda, S.P., M.P.
UNIVERSITAS GADJAH MADA Luonita M. A. Motto, Ayaya, Eder Heroma, id/R. 2019. Molecular events occurring during softening of strawberry fruit. *Frontiers in Plant Science*, 10: 1-19. <https://doi.org/10.3389/fpls.2019.00615>.
- Moriya, S., Kunihisa, M., Okada, K., Iwanami, H., Iwata, H., Minamikawa, M., Katayose, Y., Matsumoto, T., Mori, S., Sasaki, Matsumoto, T., Nishitani, C., Terakami, S., Yamamoto, T., dan Abe, K. 2017. Identification of QTLs for flesh mealiness in apple (*Malus x domestica* Borkh.). *The Horticulture Journal*, 86:159-170. <https://doi.org/10.2503/hortj.MI-156>.
- Murayama, H., Sai, M., Oikawa, A., dan Itai, A. 2015. Inhibitory factors that affect the ripening of pear fruit on the tree. *The Horticulture Journal*, 84: 14-20. <https://doi.org/10.2503/hortj.MI-015>.
- Newman, R. H., dan Redgwell, R. J. 2002. Cell wall changes in ripening kiwifruit: C-13 solid state NMR characterization of relatively rigid cell wall polymers. *Carbohydrate Polymers*, 49: 121-129.
- Niaz, K., Fazlullah, K., dan Muhammad, A.S. 2020. Analysis of carbohydrates (monosaccharides, polysaccharides). *Natural Products Analysis*: 621-633.
- Nilo-Poyanco, R., Vizoso, P., Sanhueza, D., Balic, I, Meneses, C., Orellana, A., dan Campos-Vargas, R., 2019. A *Prunus persica* genome wide RNA-seq approach uncovers major differences in the transcriptome among chilling injury sensitive and non-sensitive varieties. *Physiologia Plantarum*, 166: 772-793. <https://doi.org/10.1111/ppl.12831>.
- Nissen, R., Sally, B., Rajandra, A., dan Ian, C. 2018. Factor affecting post-harvest management of apples. Tasmanian Institute of Agriculture.
- Nobile, P.M., Wattebled, F., Quecini, V., Girardi, C.L., Lormeau, M., dan Laurens, F., 2011. Identification of a novel a-L-arabinofuranosidase gene associated with mealiness in apple. *Journal of Experimental Botany*, 62: 4309-4321. <https://doi.org/10.1093/jxb/err146>
- O'Neill, M. A., Ishii, T., Albersheim, P., dan Darvill, A. G. 2004. Rhamnogalacturonan II: Structure and function of a borate crosslinked cell wall pectic polysaccharide, *Annu. Rev. Plant Biology*, 1(55): 109-139.
- Payasi, A., Mishra, N.N., Chaves, A.L.S., dan Singh, R. 2009. Biochemistry of fruit softening: an overview. *Physiol. Mol. Biol. Plants*, 15(2): 103- 113.
- Percy A.E., Melton, L.D., dan Jameson, P.E. 2016. Xyloglucan and hemicelluloses in the cell wall during apple fruit development and ripening. *Plant Sci.*, 125: 31-39.
- Qi, X., Wei, J., Li, H., dan Zhao, D. 2015. Cell wall metabolism and related gene expression in *Malus domestica* Borkh. during fruit growth and softening. *Fruit Journal*, 70:153-161. DOI: 10.1051/fruits/2015006.
- Rieger, M. 2006. Introduction to fruit crops. Food Products Press, Binghamton.
- Saxena, R., Adhikari, D., dan Goyal, H. 2009. Biomass- based energy fuel through biochemical routes: A review. *Renewable and sustainable energy review* 13(1): 167-178.
- Samonte, S.O. PB., Wilson, L. T., dan Mc-Clung, A. M. 1998. Path analysis and yield-related traits of fifteen diverse rice genotype. *Crop Science*, 38: 1130-1136.
- Segonne, S.M., Bruneau, M., Celton, J., Gall, S.L., Francin-Allami, M., Juchaux, M., Laurens, F., Orsel, M., dan Renou, J. 2014. Multiscale investigation of



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- University of Malaya, <https://doi.org/10.1186/s12870-014-0375-3> methylesterase during fruit maturation. BMC Plant Biol., 14: 1-18. DOI 10.1186/s12870-014-0375-3.
- Selvendran, R.R., dan O'Neill, M.A. 1987. Isolation and analysis cell walls from plant materials. Methods Biochem Anal., 32: 25-153.
- Sheffield, C.S., Ngo, H.T., dan Azzu, N. 2016. A manual on apple pollination. Food and Agriculture organization of the United Nations, Rome.
- Singh, U., dan Verma, R.C. 2016. Textural characteristics of guava at different stage of maturity. South Asian J. Food Technology Environment, 2(2):354-360.
- Smith, H. 1977. The molecular biology of plant cells. Berkeley: University of California Press.
- Stanley, J., Prakash, R., Marshall, R., Schröder, R. 2013. Effect of harvest maturity and cold storage on correlations between fruit properties during ripening of apricot (*Prunus armeniaca*). Postharvest Biology and Technology, 82: 39-50. <https://doi.org/10.1016/j.postharvbio.2013.02.020>.
- Szczesniak, A.S. 2002. Texture is a sensory property. Food Quality and Preference, 13: 215-225.
- Tacken, E., Ireland, H., Gunaseelan, K., Karunairetman, S., Wang, D., Schultz, K., Bowen J., Atkinson, R.G., Johnston, J.W., Putterill, J., Roger, P.H., dan Robert, J.S. 2010. The role of ethylene and cold temperature in the regulation of the apple polygalacturonase 1 gene and fruit ripening. Plant physiol., 253: 294- 305.
- Tan, X., Kaixia, L., Zheng, W., Keming, Z., Xiaoli, T., dan Jun, C. 2019. A review of plant vacuoles: formation, located proteins and functions. Plants, 8(9): 327.
- Taylor, T. 2009. Introduction to vascular plant morphology and anatomy. Biology and Evolution of Fossil Plants, 201-222.
- Terefe, N.S. dan Cornelis, V. 2011. Texture and microstructure of fruits and vegetables. Chapter 4 (Part I) in Practical Food and Research. CSIRO Food Science and Nutrition. Australia.
- Toivonen, P.M.A., dan Brummel, D.A. 2008. Biochemical bases of appearance and texture changes in fresh cut fruit and vegetables. Postharvest Biology and Technology, 48:1-14.
- Tripathi, K., Saurabh P., Murtaza, M., dan Tanushri, K. 2015. Fruit ripening of climacteric and non-climacteric fruit. Journal of Environmental and Applied Bioresearch, 4(1): 27-34.
- Tucker, G. A. 1993. Fruit ripening. In the biochemistry of fruit ripening. Eds. Chapman & Hall: London, pp 1-51.
- USDA (United States Department of Agriculture). 2012. Plants database. <https://plants.usda.gov/>. Diakses pada 3 Januari 2021.
- Wang, D., Haiyan, Z., Fuwang, W., Taotao, L., Yuxiang, L., dan Xuewu, D. 2013. Modification of pectin and hemicellulose polysaccharides relation to aril breakdown of harvested longan fruit. International Journal Molecular Science, 14: 23356-23368.
- Watkins, R., dan Smith R.A. 1982. Descriptor list for apple (*Malus*). CEC secretariat, Brussels; IBPGR Secretariat, Rome.
- Willats, W. G., McCartney, L., Mackie, W., dan Knox, J.P. 2001. Pectin: cell biology and prospects for functional analysis. Plant Molecular Biology, 47: 9-27.



- Characterization of fruit quality attributes and cell wall metabolism in 1-Methylcyclopropene (1-MCP) treated summer king and green ball apples during cold storage. *Frontiers in Plant Science*, 10:1-12.
- Winarno, F.G. 2004. Kimia pangan dan gizi. PT. Gramedia Pustaka Utama. Jakarta.
- Yapo, B.M. 2011. Rhamnogalacturonan-I: A structurally puzzling and functionally versatile polysaccharide from plant cell walls and mucilages. *Polym*, 51: 391- 413.
- Yoshioka, H., Aoba, K., dan Kashimura, Y. 1992. Molecular weight and degree of methoxylation in cell wall polyuronide during softening in deer and in apple fruit. *J. Amer. Soc. Hort. Sci.*, 117 (4): 600-606
- Zhang, S., Ma, M., Zhang, H., Qian, M., Zhang, Z., Luo, W., Fan, J., Liu, Z., dan Wang, L. 2019. Genome-wide analysis of polygalacturonase gene family from pear genome and identification of the member involved in pear softening. *BMC Plant Biology*, 19: 1-12. <https://doi.org/10.1186/s12870-019-2168-1>.