

## References

- Aiello, A., Farzaneh, F., Candore, G., Caruso, C., Davinelli, S., Gambino, C. M., ... & Accardi, G. (2019). Immunosenescence and its hallmarks: how to oppose aging strategically? A review of potential options for therapeutic intervention. *Frontiers in immunology*, 10, 2247.
- American Type Culture Collection. (n.d.). Passage number effects in cell lines | ATCC. <https://www.atcc.org>.  
<https://www.atcc.org/resources/technical-documents/passage-number-effects-in-cell-lines>
- Ames, B. N., Shigenaga, M. K., & Hagen, T. M. (1995). Mitochondrial decay in aging. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease*, 1271(1), 165-170.
- Arany, I., Megyesi, J. K., Kaneto, H., Tanaka, S., & Safirstein, R. L. (2004). Activation of ERK or inhibition of JNK ameliorates H<sub>2</sub>O<sub>2</sub> cytotoxicity in mouse renal proximal tubule cells. *Kidney international*, 65(4), 1231-1239.
- Asakawa, Y. (2008). Liverworts-potential source of medicinal compounds. *Current pharmaceutical design*, 14(29), 3067-3088.
- Asakawa, Y., Ludwiczuk, A., & Nagashima, F. (2009). Bryophytes: bio-and chemical diversity, bioactivity and chemosystematics. *Heterocycles*, 77(1), 99-150.
- Babior, B. M., Kipnes, R. S., & Curnutte, J. T. (1973). Biological defense mechanisms. The production by leukocytes of superoxide, a potential bactericidal agent. *The Journal of clinical investigation*, 52(3), 741-744.
- Balaban, R. S., Nemoto, S., & Finkel, T. (2005). Mitochondria, oxidants, and aging. *cell*, 120(4), 483-495.
- Barnett, K., Mercer, S. W., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *The Lancet*, 380(9836), 37-43.
- Beckman, K. B., & Ames, B. N. (1998). The free radical theory of aging matures. *Physiological reviews*.

- Berger, M. M. (2005). Can oxidative damage be treated nutritionally?. *Clinical nutrition*, 24(2), 172-183.
- bio-rad. (n.d.). PCR troubleshooting. <https://www.bio-rad.com/>.  
<https://www.bio-rad.com/en-id/applications-technologies/pcr-troubleshooting?ID=LUSO3HC4S>
- Biosearch Technologies. (2011). QPCR troubleshooting: Interpreting amplification curves and diagnosing problems. *The BiosearchTech Blog*.  
<https://blog.biosearchtech.com/thebiosearchtechblog/bid/63622/qpcr-troubleshooting>
- Birben, E., Sahiner, U. M., Sackesen, C., Erzurum, S., & Kalayci, O. (2012). Oxidative stress and antioxidant defense. *World allergy organization journal*, 5(1), 9-19.
- Boukamp, P., Petrussevska, R. T., Breitkreutz, D., Hornung, J., Markham, A., & Fusenig, N. E. (1988). Normal keratinization in a spontaneously immortalized aneuploid human keratinocyte cell line. *The Journal of cell biology*, 106(3), 761-771.
- Brighente, I. M. C., Dias, M., Verdi, L. G., & Pizzolatti, M. G. (2007). Antioxidant activity and total phenolic content of some Brazilian species. *Pharmaceutical biology*, 45(2), 156-161.
- Buettner, G. R. (1993). The pecking order of free radicals and antioxidants: lipid peroxidation,  $\alpha$ -tocopherol, and ascorbate. *Archives of biochemistry and biophysics*, 300(2), 535-543.
- Burtner, C. R., & Kennedy, B. K. (2010). Progeria syndromes and ageing: what is the connection?. *Nature reviews Molecular cell biology*, 11(8), 567-578.
- Bustin, S. A. (2002). INVITED REVIEW Quantification of mRNA using real-time reverse transcription PCR (RT-PCR): trends and problems. *Journal of molecular endocrinology*, 29, 23-39.
- Cao, G., Sofic, E., & Prior, R. L. (1997). Antioxidant and prooxidant behavior of flavonoids: structure-activity relationships. *Free radical biology and medicine*, 22(5), 749-760.
- Centers for Disease Control and Prevention. (2022). Basic molecular biology: PCR and real-time PCR - centers for disease ... <https://www.cdc.gov>.

[https://www.cdc.gov/labtraining/videos/basic-molecular-biology/molecular\\_principles\\_of\\_pcr/principle-of-PCR\\_Script.pdf](https://www.cdc.gov/labtraining/videos/basic-molecular-biology/molecular_principles_of_pcr/principle-of-PCR_Script.pdf)

- Chen, Z., Seo, J. Y., Kim, Y. K., Lee, S. R., Kim, K. H., Cho, K. H., ... & Chung, J. H. (2005). Heat modulation of tropoelastin, fibrillin-1, and matrix metalloproteinase-12 in human skin in vivo. *Journal of investigative dermatology*, 124(1), 70-78.
- Choksi, K. B., Roberts II, L. J., DeFord, J. H., Rabek, J. P., & Papaconstantinou, J. (2007). Lower levels of F2-isoprostanes in serum and livers of long-lived Ames dwarf mice. *Biochemical and biophysical research communications*, 364(4), 761-764.
- Chosewood, C. (2012, July 19). Safer and healthier at any age: Strategies for an aging workforce. Retrieved November 9, 2022, from <https://blogs.cdc.gov/niosh-science-blog/2012/07/19/agingworkforce/>
- Chun, O. K., Kim, D. O., & Lee, C. Y. (2003). Superoxide radical scavenging activity of the major polyphenols in fresh plums. *Journal of agricultural and food chemistry*, 51(27), 8067-8072.
- Clemens, M. R., Ladner, C., Ehninger, G., Einsele, H., Renn, W., Bühler, E., ... & Gey, K. F. (1990). Plasma vitamin E and beta-carotene concentrations during radiochemotherapy preceding bone marrow transplantation. *The American journal of clinical nutrition*, 51(2), 216-219.
- Cooke, M. S., Evans, M. D., Dizdaroglu, M., & Lunec, J. (2003). Oxidative DNA damage: mechanisms, mutation, and disease. *The FASEB Journal*, 17(10), 1195-1214.
- Coppé, J. P., Desprez, P. Y., Krtolica, A., & Campisi, J. (2010). The senescence-associated secretory phenotype: the dark side of tumor suppression. *Annual review of pathology: mechanisms of disease*, 5, 99-118.
- Corrêa, R. C., Peralta, R. M., Haminiuk, C. W., Maciel, G. M., Bracht, A., & Ferreira, I. C. (2018). New phytochemicals as potential human anti-aging compounds: Reality, promise, and challenges. *Critical reviews in food science and nutrition*, 58(6), 942-957.
- Cui, B., Wang, Y., Jin, J., Yang, Z., Guo, R., Li, X., ... & Li, Z. (2022). Resveratrol treats UVB-induced photoaging by anti-MMP expression, through anti-inflammatory, antioxidant, and

- antiapoptotic properties, and treats photoaging by upregulating VEGF-B expression. *Oxidative Medicine and Cellular Longevity*, 2022.
- Devasagayam, T. P. A., Tilak, J. C., Boloor, K. K., Sane, K. S., Ghaskadbi, S. S., & Lele, R. D. (2004). Free radicals and antioxidants in human health: current status and future prospects. *Japi*, 52(794804), 4.
- Di Micco, R., Krizhanovsky, V., Baker, D., & d'Adda di Fagagna, F. (2021). Cellular senescence in ageing: from mechanisms to therapeutic opportunities. *Nature reviews Molecular cell biology*, 22(2), 75-95.
- Di Lullo, G. A., Sweeney, S. M., Korkko, J., Ala-Kokko, L., & San Antonio, J. D. (2002). Mapping the ligand-binding sites and disease-associated mutations on the most abundant protein in the human, type I collagen. *Journal of Biological Chemistry*, 277(6), 4223-4231.
- Duduk, K., Rosalam, S., & Awang, B. (2007). Phytochemical antioxidants for health and medicine – A move towards nature. *Biotechnology and Molecular Biology Reviews*, 2(4), 97-104.
- Domínguez, R., Pateiro, M., Gagaoua, M., Barba, F. J., Zhang, W., & Lorenzo, J. M. (2019). A comprehensive review on lipid oxidation in meat and meat products. *Antioxidants*, 8(10), 429.
- Elmets, C. A., Singh, D., Tubesing, K., Matsui, M., Katiyar, S., & Mukhtar, H. (2001). Cutaneous photoprotection from ultraviolet injury by green tea polyphenols. *Journal of the American Academy of Dermatology*, 44(3), 425-432.
- Fadhilla, R., Iskandar, E. A., & Kusumaningrum, H. D. (2012). Aktivitas Antibakteri Ekstrak Tumbuhan Lumut Hati (*Marchantia paleacea*) Terhadap Bakteri Patogen dan Perusak Pangan [Antibacterial Activity of Liverwort (*Marchantia paleacea*) Extract on Pathogenic and Food Spoilage Bacteria]. *Jurnal Teknologi dan Industri Pangan*, 23(2), 126-126.
- Feng, M.(2018). Role Of COX2 In Cellular Senescence. (Doctoral dissertation). Retrieved from <https://scholarcommons.sc.edu/etd/4722>

- Ferrucci, L., & Fabbri, E. (2018). Inflammageing: chronic inflammation in ageing, cardiovascular disease, and frailty. *Nature Reviews Cardiology*, 15(9), 505-522.
- Fisher, G. J., Kang, S., Varani, J., Bata-Csorgo, Z., Wan, Y., Datta, S., & Voorhees, J. J. (2002). Mechanisms of photoaging and chronological skin aging. *Archives of dermatology*, 138(11), 1462-1470.
- Fisher, G. J., Quan, T., Purohit, T., Shao, Y., Cho, M. K., He, T., ... & Voorhees, J. J. (2009). Collagen fragmentation promotes oxidative stress and elevates matrix metalloproteinase-1 in fibroblasts in aged human skin. *The American journal of pathology*, 174(1), 101-114.
- Flockhart, R. J., Diffey, B. L., Farr, P. M., Lloyd, J., & Reynolds, N. J. (2008). NFAT regulates induction of COX-2 and apoptosis of keratinocytes in response to ultraviolet radiation exposure. *The FASEB Journal*, 22(12), 4218-4227.
- Ganceviciene, R., Liakou, A. I., Theodoridis, A., Makrantonaki, E., & Zouboulis, C. C. (2012). Skin anti-aging strategies. *Dermato-endocrinology*, 4(3), 308-319.
- Green, D. R., Galluzzi, L., & Kroemer, G. (2011). Mitochondria and the autophagy–inflammation–cell death axis in organismal aging. *Science*, 333(6046), 1109-1112.
- Gregg, S. Q., Gutiérrez, V., Rasile Robinson, A., Woodell, T., Nakao, A., Ross, M. A., ... & Niedernhofer, L. J. (2012). A mouse model of accelerated liver aging caused by a defect in DNA repair. *Hepatology*, 55(2), 609-621.
- Gülden, M., Jess, A., Kammann, J., Maser, E., & Seibert, H. (2010). Cytotoxic potency of H<sub>2</sub>O<sub>2</sub> in cell cultures: impact of cell concentration and exposure time. *Free Radical Biology and Medicine*, 49(8), 1298-1305.
- Habli, Z., Toumieh, G., Fatfat, M., Rahal, O. N., & Gali-Muhtasib, H. (2017). Emerging cytotoxic alkaloids in the battle against cancer: Overview of molecular mechanisms. *Molecules*, 22(2), 250.
- Harman, D. (1965). The free radical theory of aging: effect of age on serum copper levels. *Journal of gerontology*, 20(2), 151-153.

- Harman, D. (2001). Aging: overview. *Annals of the New York Academy of Sciences*, 928(1), 1-21.
- Harraan, D. (1955). Aging: a theory based on free radical and radiation chemistry.
- Hayflick, L. (1965). The limited in vitro lifetime of human diploid cell strains. *Experimental cell research*, 37(3), 614-636.
- Hayyan, M., Hashim, M. A., & AlNashef, I. M. (2016). Superoxide ion: generation and chemical implications. *Chemical reviews*, 116(5), 3029-3085.
- He, W., Goodkind, D., & Kowal, P. R. (2016). An aging world: 2015.
- He, T., Quan, T., Shao, Y., Voorhees, J. J., & Fisher, G. J. (2014). Oxidative exposure impairs TGF- $\beta$  pathway via reduction of type II receptor and SMAD3 in human skin fibroblasts. *Age*, 36, 1079-1094.
- Hekimi, S., Lapointe, J., & Wen, Y. (2011). Taking a "good" look at free radicals in the aging process. *Trends in cell biology*, 21(10), 569-576.
- Hoeijmakers, J. H. (2009). DNA damage, aging, and cancer. *New England Journal of Medicine*, 361(15), 1475-1485.
- Hsiao, G., Teng, C. M., Wu, C. L., & Ko, F. N. (1996). Marchantin H as a natural antioxidant and free radical scavenger. *Archives of biochemistry and biophysics*, 334(1), 18-26.
- Huang, W. J., Wu, C. L., Lin, C. W., Chi, L. L., Chen, P. Y., Chiu, C. J., ... & Chen, C. N. (2010). Marchantin A, a cyclic bis (bibenzyl ether), isolated from the liverwort *Marchantia emarginata* subsp. *tosana* induces apoptosis in human MCF-7 breast cancer cells. *Cancer letters*, 291(1), 108-119.
- Hwang, E., Lee, T. H., Park, S. Y., Yi, T. H., & Kim, S. Y. (2014). Enzyme-modified *Panax ginseng* inhibits UVB-induced skin aging through the regulation of procollagen type I and MMP-1 expression. *Food & function*, 5(2), 265-274.
- Inés, C. D., Reina, M., Gavín, J. A., & González-Coloma, A. (2006). In vitro cytotoxicity of norditerpenoid alkaloids. *Zeitschrift für Naturforschung C*, 61(1-2), 11-18.

- Institute of Medicine. (2000). Vitamin C. In *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids* (1st ed., p. 96). essay, National Academies Press.
- Jacob, R. A. (1995). The integrated antioxidant system. *Nutrition research*, 15(5), 755-766.
- Jacobson, A., Yan, C., Gao, Q., Rincon-Skinner, T., Rivera, A., Edwards, J., ... & Sun, D. (2007). Aging enhances pressure-induced arterial superoxide formation. *American Journal of Physiology-Heart and Circulatory Physiology*, 293(3), H1344-H1350.
- Jiang, H., Sun, J., Xu, Q., Liu, Y., Wei, J., Young, C. Y., ... & Lou, H. (2013). Marchantin M: a novel inhibitor of proteasome induces autophagic cell death in prostate cancer cells. *Cell death & disease*, 4(8), e761-e761.
- Juan, C. A., Pérez de la Lastra, J. M., Plou, F. J., & Pérez-Lebeña, E. (2021). The chemistry of reactive oxygen species (ROS) revisited: outlining their role in biological macromolecules (DNA, lipids and proteins) and induced pathologies. *International Journal of Molecular Sciences*, 22(9), 4642.
- Juhász, M. L., Levin, M. K., & Marmur, E. S. (2018). The use of natural ingredients in innovative Korean cosmeceuticals. *Journal of Cosmetic Dermatology*, 17(3), 305-312.
- Kanasi, E., Ayilavarapu, S., & Jones, J. (2016). The aging population: demographics and the biology of aging. *Periodontology 2000*, 72(1), 13-18.
- Kar, S., Subbaram, S., Carrico, P. M., & Melendez, J. A. (2010). Redox-control of matrix metalloproteinase-1: a critical link between free radicals, matrix remodeling and degenerative disease. *Respiratory physiology & neurobiology*, 174(3), 299-306.
- Karin, M., Liu, Z. G., & Zandi, E. (1997). AP-1 function and regulation. *Current opinion in cell biology*, 9(2), 240-246.
- Karp, A., Isaac, P. G., & Ingram, D. S. (1998). Isolation of nucleic acids using silica-gel based membranes: Methods based on the use of QIAamp Spin Columns. *Molecular Tools for Screening Biodiversity: Plants and Animals*, 59-63.

- Kattimani, V., Tiwari, R. V. C., Gufran, K., Wasan, B., Shilpa, P. H., & Khader, A. A. (2019). Botulinum toxin application in facial esthetics and recent treatment indications (2013-2018). *Journal of International Society of Preventive & Community Dentistry*, 9(2), 99.
- Kay, J., Thadhani, E., Samson, L., & Engelward, B. (2019). Inflammation-induced DNA damage, mutations and cancer. *DNA repair*, 83, 102673.
- Kim, K. C., Kang, S. S., Lee, J. S., Park, D. H., & Hyun, J. W. (2012). Baicalein attenuates oxidative stress-induced expression of matrix metalloproteinase-1 by regulating the ERK/JNK/AP-1 pathway in human keratinocytes. *Biomolecules & Therapeutics*, 20(1), 57-61.
- Kim, J., Vaish, V., Feng, M., Field, K., Chatzistamou, I., & Shim, M. (2016). Transgenic expression of cyclooxygenase-2 (COX2) causes premature aging phenotypes in mice. *Aging (Albany NY)*, 8(10), 2392.
- Kligman, A. M., & Koblenzer, C. (1997). Demographics and psychological implications for the aging population. *Dermatologic clinics*, 15(4), 549-553.
- Kobus-Cisowska, J., Flaczyk, E., Rudzińska, M., & Kmiecik, D. (2014). Antioxidant properties of extracts from Ginkgo biloba leaves in meatballs. *Meat Science*, 97(2), 174-180.
- Koch, S., Volkmar, C. M., Kolb-Bachofen, V., Korth, H. G., Kirsch, M., Horn, A. H., ... & Suschek, C. V. (2009). A new redox-dependent mechanism of MMP-1 activity control comprising reduced low-molecular-weight thiols and oxidizing radicals. *Journal of molecular medicine*, 87(3), 261-272.
- Koga, H., Kaushik, S., & Cuervo, A. M. (2011). Protein homeostasis and aging: The importance of exquisite quality control. *Ageing research reviews*, 10(2), 205-215.
- Kolarsick, P. A., Kolarsick, M. A., & Goodwin, C. (2011). Anatomy and physiology of the skin. *Journal of the Dermatology Nurses' Association*, 3(4), 203-213.
- Kowaltowski, A. J., de Souza-Pinto, N. C., Castilho, R. F., & Vercesi, A. E. (2009). Mitochondria and reactive oxygen species. *Free Radical Biology and Medicine*, 47(4), 333-343.



- Kumar, N., & Goel, N. (2019). Phenolic acids: Natural versatile molecules with promising therapeutic applications. *Biotechnology Reports*, 24, e00370.
- Laurell, H., Iacovoni, J. S., Abot, A., Svec, D., Maoret, J. J., Arnal, J. F., & Kubista, M. (2012). Correction of RT-qPCR data for genomic DNA-derived signals with ValidPrime. *Nucleic acids research*, 40(7), e51-e51.
- Li, P., Gan, Y., Xu, Y., Song, L., Wang, L., Ouyang, B., ... & Zhou, Q. (2017). The inflammatory cytokine TNF- $\alpha$  promotes the premature senescence of rat nucleus pulposus cells via the PI3K/Akt signaling pathway. *Scientific reports*, 7(1), 1-12.
- Li, X., Zhang, P., Wang, H., & Yu, Y. (2022). Genes expressed at low levels raise false discovery rates in RNA samples contaminated with genomic DNA. *BMC genomics*, 23(1), 554.
- Lian, J., Yue, Y., Yu, W., & Zhang, Y. (2020). Immunosenescence: a key player in cancer development. *Journal of Hematology & Oncology*, 13, 1-18.
- Liu, L., Xie, H., Chen, X., Shi, W., Xiao, X., Lei, D., & Li, J. (2012). Differential response of normal human epidermal keratinocytes and HaCaT cells to hydrogen peroxide-induced oxidative stress. *Clinical and Experimental Dermatology: Experimental dermatology*, 37(7), 772-780.
- López-Otín, C., Blasco, M. A., Partridge, L., Serrano, M., & Kroemer, G. (2013). The hallmarks of aging. *Cell*, 153(6), 1194-1217.
- Lord, C. J., & Ashworth, A. (2012). The DNA damage response and cancer therapy. *Nature*, 481(7381), 287-294.
- Lourenço, S. C., Moldão-Martins, M., & Alves, V. D. (2019). Antioxidants of natural plant origins: From sources to food industry applications. *Molecules*, 24(22), 4132.
- Lovina, P. (2022). Phytochemical Characterization of *Marchantia paleacea*, *Pogonatum neesii*, and *Litsea Oppositifolia* Extract. Retrieved June 9, 2023,.
- Luo, C., Urgard, E., Vooder, T., & Metspalu, A. (2011). The role of COX-2 and Nrf2/ARE in anti-inflammation and antioxidative stress: Aging and anti-aging. *Medical hypotheses*, 77(2), 174-178.

- Maestas, N., Mullen, K. J., & Powell, D. (2016). The effect of population aging on economic growth, the labor force and productivity (No. w22452). National Bureau of Economic Research.
- Mahendra, C. K., Abidin, S. A. Z., Htar, T. T., Chuah, L. H., Khan, S. U., Ming, L. C., ... & Goh, B. H. (2021). Counteracting the ramifications of UVB irradiation and photoaging with *Swietenia macrophylla* King seed. *Molecules*, 26(7), 2000.
- Maruyama, H., Tamauchi, H., Kawakami, F., Yoshinaga, K., & Nakano, T. (2015). Suppressive effect of dietary fucoidan on proinflammatory immune response and MMP-1 expression in UVB-irradiated mouse skin. *Planta medica*, 81(15), 1370-1374.
- McGrath, J. A., Eady, R. A. J., & Pope, F. M. (2004). Anatomy and organization of human skin. *Rook's textbook of dermatology*, 1, 3-2.
- Mestre, J. R., Mackrell, P. J., Rivadeneira, D. E., Stapleton, P. P., Tanabe, T., & Daly, J. M. (2001). Redundancy in the signaling pathways and promoter elements regulating cyclooxygenase-2 gene expression in endotoxin-treated macrophage/monocytic cells. *Journal of Biological Chemistry*, 276(6), 3977-3982.
- Microbial. (2009). Results Interpretation Guide. [www.genomica.uaslp.mx](http://www.genomica.uaslp.mx).  
<http://www.genomica.uaslp.mx/Databases/qPCR02.pdf>
- Miller, D. M., Buettner, G. R., & Aust, S. D. (1990). Transition metals as catalysts of "autoxidation" reactions. *Free Radical Biology and Medicine*, 8(1), 95-108.
- Min, J. N., Whaley, R. A., Sharpless, N. E., Lockyer, P., Portbury, A. L., & Patterson, C. (2008). CHIP deficiency decreases longevity, with accelerated aging phenotypes accompanied by altered protein quality control. *Molecular and cellular biology*, 28(12), 4018-4025.
- Mira, L., Tereza Fernandez, M., Santos, M., Rocha, R., Helena Florêncio, M., & Jennings, K. R. (2002). Interactions of flavonoids with iron and copper ions: a mechanism for their antioxidant activity. *Free radical research*, 36(11), 1199-1208.

- Mirjany, M., Ho, L., & Pasinetti, G. M. (2002). Role of cyclooxygenase-2 in neuronal cell cycle activity and glutamate-mediated excitotoxicity. *Journal of Pharmacology and Experimental Therapeutics*, 301(2), 494-500.
- Montagna, W., & Parakkal, P. F. (1974). *The Structure and Function of Skin* (3rd ed.). Academic Press.
- Mukherjee, S., Dey, A., De, A., & Ghosh, P. (2014). Antioxidative Potential of Two Darjeeling Himalayan Marchantia sp.: *M. paleacea* and *M. papillata*.
- Mukhia, S., Mandal, P., Singh, D. K., Singh, D., & Choudhury, D. (2014). In-vitro free-radical scavenging potential of three liverworts of Darjeeling Himalaya. *International Journal of Pharmaceutical Sciences and Research*, 5(10), 4552.
- Murga, M., Bunting, S., Montana, M. F., Soria, R., Mulero, F., Canamero, M., ... & Fernandez-Capetillo, O. (2009). A mouse model of ATR-Seckel shows embryonic replicative stress and accelerated aging. *Nature genetics*, 41(8), 891-898.
- Myhrstad, M. C. W., Carlsen, H., Dahl, L. I., Ebihara, K., Glemmestad, L., Haffner, K., ... & Blomhoff, R. (2006). Bilberry extracts induce gene expression through the electrophile response element. *Nutrition and cancer*, 54(1), 94-101.
- Nelson, K. K., Ranganathan, A. C., Mansouri, J., Rodriguez, A. M., Providence, K. M., Rutter, J. L., ... & Melendez, J. A. (2003). Elevated sod2 activity augments matrix metalloproteinase expression: evidence for the involvement of endogenous hydrogen peroxide in regulating metastasis. *Clinical Cancer Research*, 9(1), 424-432.
- Ninomiya-Tsuji, J., Kishimoto, K., Hiyama, A., Inoue, J. I., Cao, Z., & Matsumoto, K. (1999). The kinase TAK1 can activate the NIK-IKB as well as the MAP kinase cascade in the IL-1 signalling pathway. *Nature*, 398(6724), 252-256.
- Njus, D., Kelley, P. M., Tu, Y. J., & Schlegel, H. B. (2020). Ascorbic acid: The chemistry underlying its antioxidant properties. *Free Radical Biology and Medicine*, 159, 37-43.
- Nusgens, B. V., Colige, A. C., Lambert, C. A., Lapière, C. M., Humbert, P., Rougier, A., ... & Creidi, P. (2001). Topically applied vitamin C enhances the mRNA level of collagens I and III, their

- processing enzymes and tissue inhibitor of matrix metalloproteinase 1 in the human dermis. *Journal of Investigative Dermatology*, 116(6), 853-859.
- Ohtani, N. (2022). The roles and mechanisms of senescence-associated secretory phenotype (SASP): can it be controlled by senolysis?. *Inflammation and Regeneration*, 42(1), 11.
- Ortiz-Montero, P., Londoño-Vallejo, A., & Vernet, J. P. (2017). Senescence-associated IL-6 and IL-8 cytokines induce a self-and cross-reinforced senescence/inflammatory milieu strengthening tumorigenic capabilities in the MCF-7 breast cancer cell line. *Cell Communication and Signaling*, 15, 1-18.
- Park, I. J., Lee, Y. K., Hwang, J. T., Kwon, D. Y., Ha, J., & Park, O. J. (2009). Green tea catechin controls apoptosis in colon cancer cells by attenuation of H<sub>2</sub>O<sub>2</sub>-stimulated COX-2 expression via the AMPK signaling pathway at low-dose H<sub>2</sub>O<sub>2</sub>. *Annals of the New York Academy of Sciences*, 1171(1), 538-544.
- Phongpaichit, S., Nikom, J., Rungjindamai, N., Sakayaroj, J., Hutadilok-Towatana, N., Rukachaisirikul, V., & Kirtikara, K. (2007). Biological activities of extracts from endophytic fungi isolated from *Garcinia* plants. *FEMS Immunology & Medical Microbiology*, 51(3), 517-525.
- Pittayapruek, P., Meephansan, J., Prapapan, O., Komine, M., & Ohtsuki, M. (2016). Role of matrix metalloproteinases in photoaging and photocarcinogenesis. *International journal of molecular sciences*, 17(6), 868.
- Prince, M. J., Wu, F., Guo, Y., Robledo, L. M. G., O'Donnell, M., Sullivan, R., & Yusuf, S. (2015). The burden of disease in older people and implications for health policy and practice. *The Lancet*, 385(9967), 549-562.
- Purkon, D. B., Iwo, M. I., Soemardhi, A. A., Rahmawati, S. F., Fadhillah, F. M., & Nadhifah, A. (2021). Immunostimulant Activity of *Marchantia paleacea* Bertol. Herb Liverworth Ethanol Extract in BALB/c Mice. *Indones. J. Pharm*, 32(4), 464-473.

- Qin, Z., Fisher, G. J., & Quan, T. (2013). Cysteine-rich protein 61 (CCN1) domain-specific stimulation of matrix metalloproteinase-1 expression through  $\alpha V\beta 3$  integrin in human skin fibroblasts. *Journal of Biological Chemistry*, 288(17), 12386-12394.
- Quan, T., & Fisher, G. J. (2015). Role of age-associated alterations of the dermal extracellular matrix microenvironment in human skin aging: a mini-review. *Gerontology*, 61(5), 427-434.
- Quan, T., Little, E., Quan, H., Voorhees, J. J., & Fisher, G. J. (2013). Elevated matrix metalloproteinases and collagen fragmentation in photodamaged human skin: impact of altered extracellular matrix microenvironment on dermal fibroblast function. *The Journal of investigative dermatology*, 133(5), 1362.
- Ramadon, D., McCrudden, M. T., Courtenay, A. J., & Donnelly, R. F. (2022). Enhancement strategies for transdermal drug delivery systems: Current trends and applications. *Drug Delivery and Translational Research*, 12(4), 758-791.
- Reddy, S. P. (2008). The antioxidant response element and oxidative stress modifiers in airway diseases. *Current molecular medicine*, 8(5), 376-383.
- Reeg, S., & Grune, T. (2015). Protein oxidation in aging: does it play a role in aging progression?. *Antioxidants & redox signaling*, 23(3), 239-255.
- Richter, C. (1995). Oxidative damage to mitochondrial DNA and its relationship to ageing. *The international journal of biochemistry & cell biology*, 27(7), 647-653.
- Riley, P. A. (1994). Free radicals in biology: oxidative stress and the effects of ionizing radiation. *International journal of radiation biology*, 65(1), 27-33.
- Rinnerthaler, M., Bischof, J., Streubel, M. K., Trost, A., & Richter, K. (2015). Oxidative stress in aging human skin. *Biomolecules*, 5(2), 545-589.
- Ririe, K. M., Rasmussen, R. P., & Wittwer, C. T. (1997). Product differentiation by analysis of DNA melting curves during the polymerase chain reaction. *Analytical biochemistry*, 245(2), 154-160.

- Rychlik, W. J. S. W., Spencer, W. J., & Rhoads, R. E. (1990). Optimization of the annealing temperature for DNA amplification in vitro. *Nucleic acids research*, 18(21), 6409-6412.
- Ryu, J. Y., & Na, E. J. (2018). MMP expression alteration and MMP-1 production control by syringic acid via AP-1 mechanism. *Biomedical Dermatology*, 2(1), 1-10.
- Samuelsson, B., Dahlen, S. E., Lindgren, J. Å., Rouzer, C. A., & Serhan, C. N. (1987). Leukotrienes and lipoxins: structures, biosynthesis, and biological effects. *Science*, 237(4819), 1171-1176.
- Sawada, M., & Carlson, J. C. (1987). Changes in superoxide radical and lipid peroxide formation in the brain, heart and liver during the lifetime of the rat. *Mechanisms of ageing and development*, 41(1-2), 125-137.
- Schürer, N., Köhne, A., Schliep, V., Barlag, K., & Goerz, G. (1993). Lipid composition and synthesis of HaCaT cells, an immortalized human keratinocyte line, in comparison with normal human adult keratinocytes. *Experimental dermatology*, 2(4), 179-185.
- Schwartner, C., Bors, W., Michel, C., Franck, U., Müller-Jakic, B., Nenninger, A., ... & Wagner, H. (1995). Effect of marchantins and related compounds on 5-lipoxygenase and cyclooxygenase and their antioxidant properties: a structure activity relationship study. *Phytomedicine*, 2(2), 113-117.
- Schwartner, C., Michel, C., Stettmaier, K., Wagner, H., & Bors, W. (1996). Marchantins and related polyphenols from liverwort: physico-chemical studies of their radical-scavenging properties. *Free Radical Biology and Medicine*, 20(2), 237-244.
- Serezani, C. H., Aronoff, D. M., Jancar, S., Mancuso, P., & Peters-Golden, M. (2005). Leukotrienes enhance the bactericidal activity of alveolar macrophages against *Klebsiella pneumoniae* through the activation of NADPH oxidase. *Blood*, 106(3), 1067-1075.
- Shi, Y. Q., Zhu, C. J., Yuan, H. Q., Li, B. Q., Gao, J., Qu, X. J., ... & Lou, H. X. (2009). Marchantin C, a novel microtubule inhibitor from liverwort with anti-tumor activity both in vivo and in vitro. *Cancer letters*, 276(2), 160-170.

- Shin, J. W., Kwon, S. H., Choi, J. Y., Na, J. I., Huh, C. H., Choi, H. R., & Park, K. C. (2019). Molecular mechanisms of dermal aging and antiaging approaches. *International journal of molecular sciences*, 20(9), 2126.
- Shin, M. H., Moon, Y. J., Seo, J. E., Lee, Y., Kim, K. H., & Chung, J. H. (2008). Reactive oxygen species produced by NADPH oxidase, xanthine oxidase, and mitochondrial electron transport system mediate heat shock-induced MMP-1 and MMP-9 expression. *Free Radical Biology and Medicine*, 44(4), 635-645.
- Shtutman, M., Chang, B. D., Schools, G. P., & Broude, E. V. (2017). Cellular model of p21-induced senescence. *Oncogene-Induced Senescence: Methods and Protocols*, 31-39.
- Singh, B., Cook, K. R., Vincent, L., Hall, C. S., Berry, J. A., Multani, A. S., & Lucci, A. (2008). Cyclooxygenase-2 induces genomic instability, BCL2 expression, doxorubicin resistance, and altered cancer-initiating cell phenotype in MCF7 breast cancer cells. *Journal of Surgical Research*, 147(2), 240-246.
- Siregar, E. S., Pasaribu, N., & Sofyan, M. Z. (2021, March). Antioxidant Activity of Liverworts *Marchantia Paleacea Bertol.* From North Sumatra Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 713, No. 1, p. 012061). IOP Publishing.
- Smith Jr, J. G., Davidson, E. A., Sams Jr, W. M., & Clark, R. D. (1962). Alterations in human dermal connective tissue with age and chronic sun damage. *Journal of Investigative Dermatology*, 39(4), 347-350.
- So, M. L., Chan, W. H., Xia, P. F., & Cui, Y. (2002). Two new cyclic bis (bibenzyl) s, isoriccardinquinone A and B from the liverwort *Marchantia paleacea*. *Natural Product Letters*, 16(3), 167-171.
- Son, Y., Cheong, Y. K., Kim, N. H., Chung, H. T., Kang, D. G., & Pae, H. O. (2011). Mitogen-activated protein kinases and reactive oxygen species: how can ROS activate MAPK pathways?. *Journal of signal transduction*, 2011.
- Song, P., An, J., & Zou, M. H. (2020). Immune clearance of senescent cells to combat ageing and chronic diseases. *Cells*, 9(3), 671.

- Sosa Torres, M. E., Saucedo-Vázquez, J. P., & Kroneck, P. M. (2015). The magic of dioxygen. In *Sustaining life on planet earth: metalloenzymes mastering dioxygen and other chewy gases* (pp. 1-12). Springer, Cham.
- Srivastava, G. P., Hanumappa, M., Kushwaha, G., Nguyen, H. T., & Xu, D. (2011). Homolog-specific PCR primer design for profiling splice variants. *Nucleic acids research*, 39(10), e69-e69.
- Stevigny, C., Bailly, C., & Quetin-Leclercq, J. (2005). Cytotoxic and antitumor potentialities of aporphinoid alkaloids. *Current Medicinal Chemistry-Anti-Cancer Agents*, 5(2), 173-182.
- Sudheesh, S., & Vijayalakshmi, N. R. (2005). Flavonoids from *Punica granatum*—potential antiperoxidative agents. *Fitoterapia*, 76(2), 181-186.
- Surowiak, P., Gansukh, T., Donizy, P., Halon, A., & Rybak, Z. (2014). Increase in cyclooxygenase-2 (COX-2) expression in keratinocytes and dermal fibroblasts in photoaged skin. *Journal of Cosmetic Dermatology*, 13(3), 195-201.
- Tajkarimi, M. M., Ibrahim, S. A., & Cliver, D. O. (2010). Antimicrobial herb and spice compounds in food. *Food control*, 21(9), 1199-1218.
- Thermo Fisher Scientific. (n.d.). Normal amplification curve: Thermo Fisher Scientific - US. Normal Amplification Curve | Thermo Fisher Scientific - US. <https://www.thermofisher.com/id/en/home/life-science/pcr/real-time-pcr/real-time-pcr-learning-center/real-time-pcr-basics/real-time-pcr-troubleshooting-tool/gene-expression-quantitation-troubleshooting/normal-amplification-curve.html>
- Tokito, A., Jougasaki, M., Ichiki, T., & Hamasaki, S. (2013). Cardiotrophin-1 induces matrix metalloproteinase-1 in human aortic endothelial cells. *PLoS one*, 8(7), e68801.
- Türkan, H., Aydın, A., & Sayal, A. (2005). Effect of volatile anesthetics on oxidative stress due to occupational exposure. *World journal of surgery*, 29, 540-542.
- Van Acker, S. A., Tromp, M. N., Griffioen, D. H., Van Bennekom, W. P., Van Der Vijgh, W. J., & Bast, A. (1996). Structural aspects of antioxidant activity of flavonoids. *Free Radical Biology and Medicine*, 20(3), 331-342.



- Velarde, M. C., Demaria, M., Melov, S., & Campisi, J. (2015). Pleiotropic age-dependent effects of mitochondrial dysfunction on epidermal stem cells. *Proceedings of the National Academy of Sciences*, 112(33), 10407-10412.
- Vincenti, M. P., & Brinckerhoff, C. E. (2002). Transcriptional regulation of collagenase (MMP-1, MMP-13) genes in arthritis: integration of complex signaling pathways for the recruitment of gene-specific transcription factors. *Arthritis research & therapy*, 4, 1-8.
- Wang, Z. H. (2014). Anti-glycative effects of asiatic acid in human keratinocyte cells. *BioMedicine*, 4(3), 1-10.
- Warren, R., Gartstein, V., Kligman, A. M., Montagna, W., Allendorf, R. A., & Ridder, G. M. (1991). Age, sunlight, and facial skin: a histologic and quantitative study. *Journal of the American Academy of Dermatology*, 25(5), 751-760.
- Witschi, H. (2005). Carcinogenic activity of cigarette smoke gas phase and its modulation by beta-carotene and N-acetylcysteine. *Toxicological Sciences*, 84(1), 81-87.
- Xu, S., Cai, Y., & Wei, Y. (2014). mTOR signaling from cellular senescence to organismal aging. *Aging and disease*, 5(4), 263.
- Yakes, F. M., & Van Houten, B. (1997). Mitochondrial DNA damage is more extensive and persists longer than nuclear DNA damage in human cells following oxidative stress. *Proceedings of the National Academy of Sciences*, 94(2), 514-519.
- Yang, W., Chen, X., Li, Y., Guo, S., Wang, Z., & Yu, X. (2020). Advances in pharmacological activities of terpenoids. *Natural Product Communications*, 15(3), 1934578X20903555.
- Yang, C., Yang, Z., Zhang, M., Dong, Q., Wang, X., Lan, A., ... & Feng, J. (2011). Hydrogen sulfide protects against chemical hypoxia-induced cytotoxicity and inflammation in HaCaT cells through inhibition of ROS/NF-KB/COX-2 pathway. *PLoS One*, 6(7), e21971.
- Yousef, H., Alhajj, M., & Sharma, S. (2017). *Anatomy, skin (integument), epidermis*.

- Zhang, X., Luo, Y., Wang, C., Ding, X., Yang, X., Wu, D., ... & Liu, M. (2018). Adipose mTORC1 suppresses prostaglandin signaling and beige adipogenesis via the CRTC2-COX-2 pathway. *Cell reports*, 24(12), 3180-3193.
- Zhu, J., Li, G., Zhou, J., Xu, Z., & Xu, J. (2022). Cytoprotective effects and antioxidant activities of acteoside and various extracts of *Clerodendrum cyrtophyllum* Turcz leaves against t-BHP induced oxidative damage. *Scientific Reports*, 12(1), 1-11.
- Zhou, J., Zheng, X., Yang, Q., Liang, Z., Li, D., Yang, X., & Xu, J. (2013). Optimization of ultrasonic-assisted extraction and radical-scavenging capacity of phenols and flavonoids from *Clerodendrum cyrtophyllum* Turcz leaves. *PloS one*, 8(7), e68392.