UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

Aas, T., Børresen, A.-L., Geisler, S., Smith-Sørensen, B., Johnsen, H., Varhaug, J.E., Akslen, L.A., and Lønning, P.E., 1996, Specific P53 mutations are associated with de novo resistance to doxorubicin in breast cancer patients, *Nat. Med.*, 2, 811–814.

Abdullah, M.N., Abd Hamid, S., Muhamad Salhimi, S., Jalil, N.A.S., Al-Amin, M., and Jumali, N.S., 2023, Design and synthesis of 1-sec/tert-butyl-2-chloro/nitrophenylbenzimidazole derivatives: Molecular docking and in vitro evaluation against MDA-MB-231 and MCF-7 cell lines, *J. Mol. Struct.*, 1277, 134828.

Al-Anazi, M., Al-Najjar, B.O., and Khairuddean, M., 2018, Structure-based drug design studies toward the discovery of novel chalcone derivatives as potential epidermal growth factor receptor (EGFR) inhibitors, *Molecules*, 23, .

Alam, S. and Khan, F., 2019, 3D-QSAR, Docking, ADME/Tox studies on Flavone analogs reveal anticancer activity through Tankyrase inhibition, *Sci. Rep.*, 9, 1–15.

Aminah, H., Hernowo, B.S., Nur, I.M., Yusuf, M., and Cara, B., 2011, Korelasi Imunoekspresi Her2 / Neu dan P53 dengan Respon Kemoterapi Cisplatin pada Karsinoma Paru Bukan-Sel Kecil, *Maj. Patol.*, 20, 27–36.

Anwar, C., Prasetyo, Y.D., Matsjeh, S., Haryadi, W., Sholikhah, E.N., and Nendrowati, N., 2018, Synthesis of Chalcone Derivatives and Their in vitro Anticancer Test Against Breast (T47D) and Colon (WiDr) Cancer Cell Line, *Indones. J. Chem.*, 18, 102.

Aponte, J.C., Verástegui, M., Málaga, E., Zimic, M., Quiliano, M., Vaisberg, A.J., Gilman, R.H., and Hammond, G.B., 2008, Synthesis, Cytotoxicity, and Anti-Trypanosoma cruzi Activity of New Chalcones, *J. Med. Chem.*, 51, 6230–6234.

Apriali, K.D., Triana, E., Farhani, M.I., Khoirunnisa, A., and Nur'aini, Y.A., 2022, Studi Penambatan Molekul dan Prediksi Admet Senyawa Metabolit Sekunder Tanaman Kelor (Moringa oleifera L.) Sebagai Inhibitor Bace1 Pada Penyakit Alzheimer, *FITOFARMAKA J. Ilm. Farm.*, 12, 58–67.

Arty, I.S., 2010, Synthesize and Citotoxicity Test of Several Compounds of Mono para-Hidroxy Chalcon, *Indo. J. Chem*, 10, 110–115.

Bandgar, B.P., Gawande, S.S., Bodade, R.G., Totre, J. V., and Khobragade, C.N., 2010, Synthesis and biological evaluation of simple methoxylated chalcones as anticancer, anti-inflammatory and antioxidant agents, *Bioorganic Med. Chem.*, 18, 1364–1370.

Bano, S., Javed, K., Ahmad, S., Rathish, I.G., Singh, S., Chaitanya, M., Arunasree, K.M., and Alam, M.S., 2013, Synthesis of some novel chalcones, flavanones and flavones and evaluation of their anti-inflammatory activity, *Eur. J. Med.*

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Chem., 65, 51–59.

Banoji, V., Kumar Angajala, K., Vianala, S., Manne, S., rao Ravulapelly, K., and Vannada, J., 2024, Synthesis, characterization, cytotoxic evaluation, and molecular docking studies of novel 1,2,3-triazole-based chalcones for potential anticancer applications, *Results Chem.*, 7, 101294.

Belaiba, M., Aldulaijan, S., Messaoudi, S., Abedrabba, M., Dhouib, A., and Bouajila, J., 2023, Evaluation of Biological Activities of Twenty Flavones and In Silico Docking Study, *Molecules*, 28, 2419.

Bibi, Z., 2008, Role of cytochrome P450 in drug interactions, *Nutr. Metab. (Lond).*, 5, 27.

Boulikas, T., 2007, Molecular mechanisms of cisplatin and its liposomally encapsulated form , Lipoplatin™ . Lipoplatin™ as a chemotherapy and antiangiogenesis drug, *Cancer Ther. Vol Cancer Ther.*, 5, 349–376.

Burdall, S.E., Hanby, A.M., Lansdown, M.R.J., and Speirs, V., 2003, Breast cancer cell lines: Friend or foe?, *Breast Cancer Res.*, 5, 89–95.

Burmaoglu, S., Algul, O., Anil, D.A., Gobek, A., Duran, G.G., Ersan, R.H., and Duran, N., 2016, Synthesis and anti-proliferative activity of fluoro-substituted chalcones, *Bioorganic Med. Chem. Lett.*, 26, 3172–3176.

Cárdenas, M., Marder, M., Blank, V.C., and Roguin, L.P., 2006, Antitumor activity of some natural flavonoids and synthetic derivatives on various human and murine cancer cell lines, *Bioorganic Med. Chem.*, 14, 2966–2971.

CCRC, 2009, Prosedur tetap uji sitotoksik metode MTT,.

Cepeda, V., Fuertes, M., Castilla, J., Alonso, C., Quevedo, C., and Perez, J., 2008, Biochemical Mechanisms of Cisplatin Cytotoxicity, *Anticancer. Agents Med. Chem.*, 7, 3–18.

Chakkaravarthy, P., Glory, J., Manikandababu, C.S., Navaneethan, S., Ramesh Kumar, B., and Raja, M., 2024, Exploring 4-chloro chalcone: Synthesis, spectroscopic, chemical reactivity, topological, hirshfeld surface, drug-Likeness, molecular docking and assessment of electronic properties in diverse solvents, *J. Mol. Liq.*, 400, 124561.

Chander, S., Tang, C.-R., Al-Maqtari, H.M., Jamalis, J., Penta, A., Hadda, T. Ben, Sirat, H.M., Zheng, Y.-T., and Sankaranarayanan, M., 2017, Synthesis and study of anti-HIV-1 RT activity of 5-benzoyl-4-methyl-1,3,4,5-tetrahydro- 2H -1,5-benzodiazepin-2-one derivatives, *Bioorg. Chem.*, 72, 74–79.

Cheng, F., Li, W., Liu, G., and Tang, Y., 2013, In Silico ADMET Prediction: Recent Advances, Current Challenges and Future Trends, *Curr. Top. Med. Chem.*, 13, 1273–1289.

Cheng, F., Li, W., Zhou, Y., Shen, J., Wu, Z., Liu, G., Lee, P.W., and Tang, Y., 2012, admetSAR: A Comprehensive Source and Free Tool for Assessment of Chemical ADMET Properties, *J. Chem. Inf. Model.*, 52, 3099–3105.

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Choudhary, A.L. and Juyal, V., 2011, Synthesis of chalcone and their derivatives as antimicrobial agents, *Int. J. Pharm. Pharm. Sci.*, 3, 125–128.

Choy, P.Y. and Kwong, F.Y., 2013, Palladium-Catalyzed ortho -CH-Bond Oxygenation of Aromatic Ketones, *Org. Lett.*, 15, 270–273.

Ciardiello, F. and Tortora, G., 2003, Epidermal growth factor receptor (EGFR) as a target in cancer therapy: understanding the role of receptor expression and other molecular determinants that could influence the response to anti-EGFR drugs, *Eur. J. Cancer*, 39, 1348–1354.

Constantinescu, T. and Lungu, C.N., 2021, Anticancer Activity of Natural and Synthetic Chalcones, *Int. J. Mol. Sci.*, 22, 11306.

Danesi, R., 2003, Pharmacogenetics of Anticancer Drug Sensitivity in Non-Small Cell Lung Cancer, *Pharmacol. Rev.*, 55, 57–103.

Danova, A., Nguyen, D.V., Toyoda, R., Mahalapbutr, P., Rungrotmongkol, T., Wonganan, P., and Chavasiri, W., 2023, 3′,4′,5′-trimethoxy- and 3,4-dimethoxychalcones targeting A549 cells: Synthesis, cytotoxic activity, and molecular docking, *J. Mol. Struct.*, 1275, 134572.

Ekins, S., Mestres, J., and Testa, B., 2007, In silico pharmacology for drug discovery: methods for virtual ligand screening and profiling, *Br. J. Pharmacol.*, 152, 9–20.

El-Meligie, S., Taher, A.T., Kamal, A.M., and Youssef, A., 2017, Design, synthesis and cytotoxic activity of certain novel chalcone analogous compounds, *Eur. J. Med. Chem.*, 126, 52–60.

Evranos Aksöz, B. and Ertan, R., 2011, Chemical and structural properties of chalcones I, *Fabad J. Pharm. Sci.*, 36, 223–242.

Ferreira, L., dos Santos, R., Oliva, G., and Andricopulo, A., 2015, Molecular Docking and Structure-Based Drug Design Strategies, *Molecules*, 20, 13384–13421.

Fikroh, R.A., Matsjeh, S., and Anwar, C., 2020, Synthesis and anticancer activity of (E)-2'-hydroxy-2-bromo-4,5-dimethoxychalcone against breast cancer (MCF-7) cell line, *Molekul*, 15, 34–39.

Goodwin, E.C. and DiMaio, D., 2000, Repression of Human Papillomavirus Oncogenes in HeLa Cervical Carcinoma Cells Causes the Orderly Reactivation of Dormant Tumor Suppressor Pathways, *Proc. Natl. Acad. Sci.*, 97, 12513–12518.

Gunasekaran, V., Yuvakkumar, R., Ganesan, R., Palapetta, S.C., and Gurusamy, H., 2023, Biological evaluation of polycyclic chalcone based acrylamides in human MCF-7 and HeLa cancer cell lines, *Environ. Res.*, 222, 115395.

Gundogdu, Ö., 2023, Molecular Docking Studies and ADME Predictions on Synthesized Chalcone Compounds Targeting EGFR, *Hittite J. Sci. Eng.*, 10, 167–175.

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Hagar, F.F., Abbas, S.H., Gomaa, H.A.M., Youssif, B.G.M., Sayed, A.M., Abdelhamid, D., and Abdel-Aziz, M., 2023, Chalcone/1,3,4-Oxadiazole/Benzimidazole hybrids as novel anti-proliferative agents inducing apoptosis and inhibiting EGFR & BRAFV600E, *BMC Chem.*, 17, 116.

Handoko, F.F., Maruti, A.A., Rivanti, E., Putri, D.D.P., and Meiyanto, E., 2012, Aktivitas Sitotoksik Ekstrak Etanolik Rimpang Temu Kunci (Boesenbergia pandurata) Terhadap Sel Kanker Serviks {HeLa} dan Sel Kanker Kolon {WiDr}, *Maj. Kesehat. Pharmamedika*, 3, 222–226.

Hasibuan, P.A.Z., Harahap, U., Sitorus, P., Lubis, M.F., and Satria, D., 2021, In-silico analysis of vernonioside d and vernonioside e from vernonia amygdalina delile. Leaves as inhibitor of epidermal growth factor receptor (egfr) and mammalian target of rapamycin (mtor), *Rasayan J. Chem.*, 14, 1539–1543.

Heffeter, P., Jakupec, M.A., Körner, W., Chiba, P., Pirker, C., Dornetshuber, R., Elbling, L., Sutterlüty, H., Micksche, M., Keppler, B.K., and Berger, W., 2007, Multidrug-resistant cancer cells are preferential targets of the new antineoplastic lanthanum compound KP772 (FFC24), *Biochem. Pharmacol.*, 73, 1873–1886.

Huang, S.-Y. and Zou, X., 2010, Advances and Challenges in Protein-Ligand Docking, *Int. J. Mol. Sci.*, 11, 3016–3034.

Iranshahi, M., Sahebkar, A., Hosseini, S.T., Takasaki, M., Konoshima, T., and Tokuda, H., 2010, Cancer Chemopreventive Activity of Diversin from Ferula Diversivittata in Vitro and in Vivo, *Phytomedicine*, 17, 269–273.

Janecka-Widła, A., Majchrzyk, K., Mucha-Małecka, A., and Biesaga, B., 2021, EGFR/PI3K/Akt/mTOR pathway in head and neck squamous cell carcinoma patients with different HPV status, *Polish J. Pathol.*, 72, 296–314.

Jasril, J., Ikhtiarudin, I., Zamri, A., Teruna, H.Y., and Frimayanti, N., 2017, New fluorinated chalcone and pyrazoline analogs: Synthesis, docking, and molecular dynamic studies as anticancer agents, *Thai J. Pharm. Sci.*, 41, 93–98.

Juvale, K., Stefan, K., and Wiese, M., 2013, Synthesis and biological evaluation of flavones and benzoflavones as inhibitors of BCRP/ABCG2, *Eur. J. Med. Chem.*, 67, 115–126.

Kandakatla, N., Ramakrishnan, G., Karthikeyan, J., and Chekkara, R., 2014, Pharmacophore modeling, atom based 3D-QSAR and docking studies of Chalcone derivatives as tubulin inhibitors, *Orient. J. Chem.*, 30, 1083–1098.

Karthikeyan, C., Narayana Moorthy, N.S.H., Ramasamy, S., Vanam, U., Manivannan, E., Karunagaran, D., and Trivedi, P., 2015, Advances in Chalcones with Anticancer Activities, *Recent Pat. Anticancer. Drug Discov.*, 10, 97–115.

Ketabforoosh, S.H.M.E., Kheirollahi, A., Safavi, M., Esmati, N., Ardestani, S.K., Emami, S., Firoozpour, L., Shafiee, A., and Foroumadi, A., 2014, Synthesis

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

and Anti-Cancer Activity Evaluation of New Dimethoxylated Chalcone and Flavanone Analogs, *Arch. Pharm. (Weinheim).*, 347, 853–860.

Khonkarn, R., Mankhetkorn, S., Talelli, M., Hennink, W.E., and Okonogi, S., 2012, Cytostatic effect of xanthone-loaded mPEG-b-p(HPMAm-Lac 2) micelles towards doxorubicin sensitive and resistant cancer cells, *Colloids Surfaces B Biointerfaces*, 94, 266–273.

Kirchmair, J., Göller, A.H., Lang, D., Kunze, J., Testa, B., Wilson, I.D., Glen, R.C., and Schneider, G., 2015, Predicting drug metabolism: experiment and/or computation?, *Nat. Rev. Drug Discov.*, 14, 387–404.

Kınalı, M., Çol, S., Çoban, C.Ç., Türk, M., Aydın, G., Emirik, M., and Baran, A., 2023, Chalcone-based dipolar cycloaddition of novel heteroaromatic compounds: Their anticancer examination, *J. Mol. Struct.*, 1293, 136244.

Krihariyani, D., Sasongkowati, R., and Haryanto, E., 2020, Studi In Silico Sifat Farmakokinetik, Toksisitas, dan Aktivitas Imunomodulator Brazilein Kayu Secang terhadap Enzim 3-Chymotrypsin-Like Cysteine Protease Coronavirus, *J. Indones. Med. Lab. Sci.*, 1, 76–85.

Kshatriya, R.B., Machhi, J.., and Nazeruddin, G.M., 2014, Novel Methodology and Process Optimization for the Synthesis of Flavones, *Int. J. Pharma Res.*, 3, 47–57.

Kuntz, S., Wenzel, U., and Daniel, H., 1999, Comparative analysis of the effects of flavonoids on proliferation, cytotoxicity, and apoptosis in human colon cancer cell lines, *Eur. J. Nutr.*, 38, 133–142.

Lawrence, N.J., Rennison, D., McGown, A.T., and Hadfield, J.A., 2003, The total synthesis of an aurone isolated from Uvaria hamiltonii: Aurones and flavones as anticancer agents, *Bioorganic Med. Chem. Lett.*, 13, 3759–3763.

Lee, D.Y., Lee, D.H., Jung, J.Y., Koh, D., Kim, G.-S., Ahn, Y.-S., Lee, Y.H., Lim, Y., and Shin, S.Y., 2016, A synthetic chalcone derivative, 2-hydroxy-3′,5,5′-trimethoxychalcone (DK-139), suppresses the TNFα-induced invasive capability of MDA-MB-231 human breast cancer cells by inhibiting NF-κB-mediated GROα expression, *Bioorg. Med. Chem. Lett.*, 26, 203–208.

Lee, J.S. and Oh, M., 2014, Reproductive factors and subtypes of breast cancer defined by estrogen receptor, progesterone receptor, and human epidermal growth factor receptor 2: A register-based study from Korea, *Clin. Breast Cancer*, 14, 426–434.

Levrero, M., De Laurenzi, V., Costanzo, A., Gong, J., Wang, J.Y., and Melino, G., 2000, The p53/p63/p73 family of transcription factors: overlapping and distinct functions., *J. Cell Sci.*, 113, 1661–1670.

Li, Y.P., Yang, Y.C., Li, Y.K., Jiang, Z.Y., Huang, X.Z., Wang, W.G., Gao, X.M., and Hu, Q.F., 2014, Prenylated chalcones from Desmodium renifolium, *Phytochem. Lett.*, 9, 41–45.

Lipinski, C.A., 2004, Lead- and drug-like compounds: the rule-of-five revolution,

UNIVERSITAS GADJAH MADA
Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Drug Discov. Today Technol., 1, 337–341.

Liu, H.C., Chen, G.G., Vlantis, A.C., Leung, B.C.S., Tong, M.C.F., and van Hasselt, C.A., 2006, 5-Fluorouracil Mediates Apoptosis and G1/S Arrest in Laryngeal Squamous Cell Carcinoma via a p53-Independent Pathway, *Cancer J.*, 12, 482–493.

Mai, C.W., Yaeghoobi, M., Abd-Rahman, N., Kang, Y.B., and Pichika, M.R., 2014, Chalcones with electron-withdrawing and electron-donating substituents: Anticancer activity against TRAIL resistant cancer cells, structure-activity relationship analysis and regulation of apoptotic proteins, *Eur. J. Med. Chem.*, 77, 378–387.

Mandge, S., Singh, H.P., Gupta, S.D., and Moorthy, N.S.H.N., 2007, Synthesis and Characterization of Some Chalcone Derivatives, *Trends Appl. Sci. Res.*, 2, 52–56.

Marquina, S., Maldonado-Santiago, M., Sánchez-Carranza, J.N., Antúnez-Mojica, M., González-Maya, L., Razo-Hernández, R.S., and Alvarez, L., 2019, Design, synthesis and QSAR study of 2′-hydroxy-4′-alkoxy chalcone derivatives that exert cytotoxic activity by the mitochondrial apoptotic pathway, *Bioorg. Med. Chem.*, 27, 43–54.

Matin, A., Gavande, N., Kim, M.S., Yang, N.X., Salam, N.K., Hanrahan, J.R., Roubin, R.H., and Hibbs, D.E., 2009, 7-Hydroxy-benzopyran-4-one Derivatives: A Novel Pharmacophore of Peroxisome Proliferator-Activated Receptor α and -γ (PPARα and γ) Dual Agonists, *J. Med. Chem.*, 52, 6835–6850.

Matsjeh, S., Anwar, C., Solikhah, E.N., Farah, H.I., and Nurfitria, K., 2017, Synthesis of 7-hydroxy-4'-methoxyflavanone and 7-hydroxy-4'-methoxyflavone as a candidate anticancer against cervical (HeLa) cancer cell and colon (WiDr) cancer cell by in vitro,. In, *AIP Conference Proceedings*., pp. 020075-1-020075-9.

Matsjeh, S., Swasono, R.T., Anwar, C., Solikhah, E.N., and Lestari, E., 2017, Synthesis of 2',4-dihydroxy-3-methoxychalcone and 2',4',4-trihydroxy-3-methoxychalcone as a candidate anticancer against cervical (WiDr), colon (HeLa), and breast (T47d) cancer cell lines in vitro,. In, *AIP Conference Proceedings*., p. 020048.

Meiyanto, E., 1999, Kurkumin sebagai obat kanker, *Menelusuri Mek. Aksinya Maj. Farm. Indones.*, 10, 224–236.

Meng, X.-Y., Zhang, H.-X., Mezei, M., and Cui, M., 2011, Molecular Docking: A Powerful Approach for Structure-Based Drug Discovery, *Curr. Comput. Aided-Drug Des.*, 7, 146–157.

Mortelmans, K., 2019, A perspective on the development of the Ames Salmonella/mammalian-microsome mutagenicity assay, *Mutat. Res. Toxicol. Environ. Mutagen.*, 841, 14–16.

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Mosmann, T., 1983, Rapid colorimetric assay for cellular growth and survival: Application to proliferation and cytotoxicity assays, *J. Immunol. Methods*, 65, 55–63.

Mukesh, B. and Rakesh, K., 2011, Molecular Docking : A Review, *Int. J. Res. Ayurveda Pharm.*, 2, 1746–1751.

Naik, M.J., 2019, MAPK signalling pathway: Role in cancer pathogenesis, *J. Crit. Rev.*, 6, 4–9.

Nurani, L.H., 2011, Uji Sitotoksisitas dan Antiproliferatif Fraksi Etil Asetat Ekstrak Etanol Biji Jinten Hitam (Nigella Sativa, Lour) terhadap Sel Mieloma, *Pharmaciana*, 1.

Nusantoro, Y.R. and Fadlan, A., 2020, Analisis Sifat Mirip Obat, Prediksi ADMET, dan Penambatan Molekular Isatinil-2-Aminobenzoilhidrazon dan kompleks logam transisi Co(II), Ni(II), Cu(II), Zn(II) Terhadap BCL2-XL, *Akta Kim. Indones.*, 5, 114.

Oliver, L., Cordel, S., Barbieux, I., LeCabellec, M.T., Meflah, K., Grégoire, M., and Vallette, F.M., 2002, Resistance to apoptosis is increased during metastatic dissemination of colon cancer, *Clin. Exp. Metastasis*, 19, 175–180.

Palozza, P., Serini, S., Maggiano, N., Tringali, G., Navarra, P., Ranelletti, F.O., and Calviello, G., 2018, β-Carotene Downregulates the Steady-State and Heregulin-α–Induced COX-2 Pathways in Colon Cancer Cells, *J. Nutr.*, 135, 129–136.

Pandurangan, M., Enkhtaivan, G., Mistry, B., Chandrasekaran, M., Noorzai, R., and Kim, D.H., 2016, Investigation of role of aspartame on apoptosis process in HeLa cells, *Saudi J. Biol. Sci.*, 23, 503–506.

Parthiban, A., Sachithanandam, V., Lalitha, P., Elumalai, D., Asha, R.N., Jeyakumar, T.C., Muthukumaran, J., Jain, M., Jayabal, K., Mageswaran, T., Sridhar, R., Purvaja, R., and Ramesh, R., 2023, Isolation and biological evaluation 7-hydroxy flavone from Avicennia officinalis L: insights from extensive in vitro , DFT, molecular docking and molecular dynamics simulation studies, *J. Biomol. Struct. Dyn.*, 41, 2848–2860.

Parvatkar, P.T., Parameswaran, P.S., and Tilve, S.G., 2012, Recent developments in the synthesis of five-and six-membered heterocycles using molecular iodine, *Chem. - A Eur. J.*, 18, 5460–5489.

Patil, C.B., Mahajan, S.K., and Katti, S.A., 2009, Chalcone: A versatile molecule, *J. Pharm. Sci. Res.*, 1, 11–22.

Pires, Blundell, T.L., and Ascher, D.B., 2015, pkCSM : predicting small-molecule pharmacokinetic properties using graph-based signatures (Theory- How to Enterpret pkCSM Result), *pKCSM*, 5.

Prajapati, C. and Reddy, M.N., 2017, Molecular Docking Studies of Canthin-6-One From Simarouba Glauca Against EGFR Tyrosine Kinase, *Int. J. Pharm. Sci. Res.*, 8, 5130–5136.

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Rahimzadeh Oskuei, S., Mirzaei, S., Reza Jafari-Nik, M., Hadizadeh, F., Eisvand, F., Mosaffa, F., and Ghodsi, R., 2021, Design, synthesis and biological evaluation of novel imidazole-chalcone derivatives as potential anticancer agents and tubulin polymerization inhibitors, *Bioorg. Chem.*, 112, 104904.

Ranjit, P.M., Rahaman, S.A., Kumar, K.P., Prasad, Y.R., Santhipriya, T., Manikanta, G.C.V.S., and Sudeepthi, N.R.L., 2013, Synthesis, screening and in vitro anticancer activity of piperazine nucleus containing novel chalcones on different cell lines, *Int. J. PharmTech Res.*, 5, 284–293.

Rizvi, S.M.D., P. Mudagal, M., S. Boregowda, S., Hussain, T., Al Hagbani, T., Abdallah, M.H., Khafagy, E.-S., Hussain, A., A. Yousif Adam, F., and S. Abu Lila, A., 2023, The flavonoid hesperidin methyl chalcone as a potential therapeutic agent for cancer therapy: Molecular docking, in vitro cytotoxicity, and in vivo antitumor activity, *Arab. J. Chem.*, 16, 104769.

Romanelli, G., Pasquale, G., Sathicq, Á., Thomas, H., Autino, J., and Vázquez, P., 2011, Synthesis of chalcones catalyzed by aminopropylated silica sol-gel under solvent-free conditions, *J. Mol. Catal. A Chem.*, 340, 24–32.

Rybka, M., Mercader, A.G., and Castro, E.A., 2014, Predictive QSAR study of chalcone derivatives cytotoxicity activity against HT-29 human colon adenocarcinoma cell lines, *Chemom. Intell. Lab. Syst.*, 132, 18–29.

Sakagami, H., Masuda, Y., Tomomura, M., Yokose, S., Uesawa, Y., Ikezoe, N., Asahara, D., Takao, K., Kanamoto, T., Terakubo, S., Kagaya, H., Nakashima, H., and Sugita, Y., 2017, Quantitative Structure–Cytotoxicity Relationship of Chalcones, *Anticancer Res.*, 37, 1091–1098.

Sampath, D., Cortes, J., Estrov, Z., Du, M., Shi, Z., Andreeff, M., Gandhi, V., and Plunkett, W., 2006, Pharmacodynamics of cytarabine alone and in combination with 7-hydroxystaurosporine (UCN-01) in AML blasts in vitro and during a clinical trial, *Blood*, 107, 2517–2524.

Samuvel Michael, D., Priya, M.K., Sidharthan, J., Kumar, M., Solomon, R.V., and Jonathan, D.R., 2021, Synthesis, crystallography, DFT, MTT assay, and molecular docking studies of an exocyclic double-bonded crystalline chalcone, *Chem. Data Collect.*, 36, 100773.

Sanduja, M., Gupta, J., Rawat, R., Singh, U., and Verma, S.M., 2020, Designing, molecular docking, and dynamics simulations studies of 1,2,3-triazole clamped Uracil–Coumarin hybrids against EGFR tyrosine kinase, *J. Appl. Pharm. Sci.*, 10, 1–11.

Sangpheak, K., Tabtimmai, L., Seetaha, S., Rungnim, C., Chavasiri, W., Wolschann, P., Choowongkomon, K., and Rungrotmongkol, T., 2019, Biological evaluation and molecular dynamics simulation of chalcone derivatives as epidermal growth factor-tyrosine kinase inhibitors, *Molecules*, 24, .

Sarda, S.R., Jadhav, W.N., and Pawar, R.P., 2009, I2-Al2O3: A suitable heterogeneous catalyst for the synthesis of flavones under microwave

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

irradiation, *Int. J. ChemTech Res.*, 1, 539–543.

Sashidhara, K. V., Kumar, M., and Kumar, A., 2012, A novel route to synthesis of flavones from salicylaldehyde and acetophenone derivatives, *Tetrahedron Lett.*, 53, 2355–2359.

Scherließ, R., 2011, The MTT assay as tool to evaluate and compare excipient toxicity in vitro on respiratory epithelial cells, *Int. J. Pharm.*, 411, 98–105.

Shah, A., Desai, K., Bhanusali, A., Malek, N., Naik, N., Thakar, A., and Shah, A., 2024, Molecular Modelling, Cytotoxicity & Biological Investigation of Novel Fluorinated Diphenylamine Chalcones Derivatives, *J. Mol. Struct.*, 138379.

Sigismund, S., Avanzato, D., and Lanzetti, L., 2018, Emerging functions of the EGFR in cancer, *Mol. Oncol.*, 12, 3–20.

Simon, L., Srinivasan, K.K., Rao, C.M., Kumar, N., Reddy, N., Biswas, S., and Moorkoth, S., 2015, Synthesis and evaluation of anti-cancer activity of some 6-Aminoflavones, *Int. J. Pharm. Chem.*, 5, 240–246.

Singh, M., Kaur, M., and Silakari, O., 2014, Flavones: An important scaffold for medicinal chemistry, *Eur. J. Med. Chem.*, 84, 206–239.

Singh, S., Sharma, P.K., Kumar, N., and Dudhe, R., 2011, Anti-oxidant Activity of 2-hydroxyacetophenone Chalcone, *J. Adv. Sci. Res.*, 2, 37–41.

Sudhesh Dev, S., Farghadani, R., Zainal Abidin, S.A., Othman, I., and Naidu, R., 2023, Flavonoids as receptor tyrosine kinase inhibitors in lung cancer, *J. Funct. Foods*, 110, 105845.

Suma, A.A.T., Wahyuningsih, T.D., and Mustofa, 2019, Efficient Synthesis of Chloro Chalcones Under Ultrasound Irradiation, Their Anticancer Activities and Molecular Docking Studies, *Rasayan J. Chem.*, 12, 502–510.

Suryani, N., Matsjeh, S., and Tri Swasono, R., 2019, Synthesis and Heme Polymerization Inhibitory Activity (HPIA) Assay of Chalcone, Flavone and Flavanone Derivatives, *Mater. Sci. Forum*, 948, 109–114.

Susanti, E., Eko Setyowati, W.A., Susanti Vh, E., and Eko Setyowati, W.A., 2018, A Green Synthesis of Chalcones As an Antioxidant and Anticancer, *IOP Conf. Ser. Mater. Sci. Eng.*, 299.

Susanti, E., Matsjeh, S., Mustofa, M., and Wahyuningsih, T.D., 2014, Improved Synthesis of 2',6'-Dihydroxy-3,4-dimethoxy Chalcone by Grinding Technique to Synthesize 5-Hydroxy-3',4'-dimethoxy Flavone, *Indones. J. Chem.*, 14, 174–178.

Syam, S., Abdelwahab, S.I., Al-Mamary, M.A., and Mohan, S., 2012, Synthesis of chalcones with anticancer activities, *Molecules*, 17, 6179–6195.

Tanamatayarat, P., Limtrakul, P., Chunsakaow, S., and Duangrat, C., 2003, Screening of Some Rubiaceous Plants for Cytotoxic Activity Against Cervix Carcinoma (KB-3-1) Cell Line, *J. Pharm. Sci.*, 27, 167–172.

UNIVERSITAS GADJAH MADA
Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Trott, O. and Olson, A.J., 2010, AutoDock Vina: Improving the speed and accuracy of docking with a new scoring function, efficient optimization, and multithreading, *J. Comput. Chem.*, 31, 455–461.

Tsuruo, T., 2003, Molecular Cancer Therapeutics: Recent Progress and Targets in Drug Resistance, *Intern. Med.*, 42, 237–243.

Venkatachalam, H., Nayak, Y., and Jayashree, B.S., 2012, Synthesis, Characterization and Antioxidant Activities of Synthetic Chalcones and Flavones, *APCBEE Procedia*, 3, 209–213.

Violette, S., Poulain, L., Dussaulx, E., Pepin, D., Faussat, A.M., Chambaz, J., Lacorte, J.M., Staedel, C., and Lesuffleur, T., 2002, Resistance of colon cancer cells to long-term 5-fluorouracil exposure is correlated to the relative level of Bcl-2 and Bcl-xL in addition to Bax and p53 status, *Int. J. Cancer*, 98, 498–504.

Wang, J., Ji, H., Niu, X., Yin, L., Wang, Y., Gu, Y., Li, D., Zhang, H., Lu, M., Zhang, F., and Zhang, Q., 2020, Sodium-Dependent Glucose Transporter 1 (SGLT1) Stabled by HER2 Promotes Breast Cancer Cell Proliferation by Activation of the PI3K/Akt/mTOR Signaling Pathway in HER2+ Breast Cancer, *Dis. Markers*, 2020, 1–12.

Wani, Z.A., Guru, S.K., Rao, A.V.S.V.S., Sharma, S., Mahajan, G., Behl, A., Kumar, A., Sharma, P.R.R., Kamal, A., Bhushan, S., and Mondhe, D.M., 2016, A novel quinazolinone chalcone derivative induces mitochondrial dependent apoptosis and inhibits PI3K/Akt/mTOR signaling pathway in human colon cancer HCT-116 cells, *Food Chem. Toxicol.*, 87, 1–11.

Wardihan, Rusdi, M., Alam, G., Lukman, and Manggau, M.A., 2013, Selective cytotoxicity evaluation in anticancer drug screening of Boehmeria virgata (Forst) guill leaves to several human cell lines: HeLa, WiDr, T47D and Vero, *Dhaka Univ. J. Pharm. Sci.*, 12, 123–126.

Way, T. Der, Kao, M.C., and Lin, J.K., 2005, Degradation of HER2/neu by apigenin induces apoptosis through cytochrome c release and caspase-3 activation in HER2/neu-overexpressing breast cancer cells, *FEBS Lett.*, 579, 145–152.

Welch, H.G. and Black, W.C., 2010, Overdiagnosis in Cancer, *J. Natl. Cancer Inst.*, 102, 605–613.

Won, S.J., Liu, C.T., Tsao, L.T., Weng, J.R., Ko, H.H., Wang, J.P., and Lin, C.N., 2005, Synthetic chalcones as potential anti-inflammatory and cancer chemopreventive agents, *Eur. J. Med. Chem.*, 40, 103–112.

Wong, H.L., 2006, A Mechanistic Study of Enhanced Doxorubicin Uptake and Retention in Multidrug Resistant Breast Cancer Cells Using a Polymer-Lipid Hybrid Nanoparticle System, *J. Pharmacol. Exp. Ther.*, 317, 1372–1381.

Workman, P., Al-Lazikani, B., and Clarke, P.A., 2013, Genome-based cancer therapeutics: Targets, kinase drug resistance and future strategies for precision oncology, *Curr. Opin. Pharmacol.*, 13, 486–496.

UNIVERSITAS
GADJAH MADA
**Sintesis Senyawa Turunan Khalkon dan Flavon dari Anisaldehid dan Veratraldehid, Penambatan Molekul
serta Uji Aktivitas Sitotoksik terhadap Cell Lines HeLa, WiDr Dan T47D**
Wisnu Pambudi, Dr. Winarto Haryadi, M.Si.; Prof. Drs. Sabirin Matsjeh, Ph.D.; Prof. Dr. Chairil Anwar
Universitas Gadjah Mada, 2024 | Diunduh dari http://etd.repository.ugm.ac.id/

Xie, Z., Luo, X., Zou, Z., Zhang, X., Huang, F., Li, R., Liao, S., and Liu, Y., 2017, Synthesis and evaluation of hydroxychalcones as multifunctional non-purine xanthine oxidase inhibitors for the treatment of hyperuricemia, *Bioorganic Med. Chem. Lett.*, 27, 3602–3606.

Yewale, C., Baradia, D., Vhora, I., Patil, S., and Misra, A., 2013, Epidermal growth factor receptor targeting in cancer: A review of trends and strategies, *Biomaterials*, 34, 8690–8707.

Zenger, K., Dutta, S., Wolff, H., Genton, M.G., and Kraus, B., 2015, In vitro structure-toxicity relationship of chalcones in human hepatic stellate cells, *Toxicology*, 336, 26–33.

Zhang, N., Yin, Y., Xu, S.-J., and Chen, W.-S., 2008, 5-Fluorouracil: Mechanisms of Resistance and Reversal Strategies, *Molecules*, 13, 1551–1569.

Zhang, Y., Liu, C., Ju, H., Jia, R., Gao, S., Liu, X., Menéndez-Arias, L., and Zhan, P., 2023, Chalcones,. In, Yu,B., Li,N., and Fu,C. (eds), *Privileged Scaffolds in Drug Discovery*. Elsevier, pp. 21–39.