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DAFTAR PUSTAKA

Ahmad, T. A., Eweida, A. E., & Sheweita, S. A. (2016). B-cell epitope mapping for the design of vaccines and effective diagnostics. *Trials in Vaccinology*, *5*, 71–83. https://doi.org/https://doi.org/10.1016/j.trivac.2016.04.003

Aksoy, S., Dizdar, O., Harputluoglu, H., & Altundag, K. (2007). Demographic, clinical, and pathological characteristics of Turkish triple-negative breast cancer patients: single center experience. In *Annals of oncology: official journal of the European Society for Medical Oncology* (Vol. 18, Issue 11, pp. 1904–1906). https://doi.org/10.1093/annonc/mdm487

Albekairi, T. H., Alshammari, A., Alharbi, M., Alshammary, A. F., Tahir ul Qamar, M., Anwar, T., Ismail, S., Shaker, B., & Ahmad, S. (2022). Design of a Multi-Epitope Vaccine against Tropheryma whipplei Using Immunoinformatics and Molecular Dynamics Simulation Techniques. In *Vaccines* (Vol. 10, Issue 5). https://doi.org/10.3390/vaccines10050691

Ali, S., Hassan, Md., Islam, A., & Ahmad, F. (2014). A Review of Methods Available to Estimate Solvent-Accessible Surface Areas of Soluble Proteins in the Folded and Unfolded States. *Current Protein & Peptide Science*, *15*(5), 456–476. https://doi.org/10.2174/1389203715666140327114232

Almeida, L. G., Sakabe, N. J., deOliveira, A. R., Silva, M. C. C., Mundstein, A. S., Cohen, T., Chen, Y.-T., Chua, R., Gurung, S., Gnjatic, S., Jungbluth, A. A., Caballero, O. L., Bairoch, A., Kiesler, E., White, S. L., Simpson, A. J. G., Old, L. J., Camargo, A. A., & Vasconcelos, A. T. R. (2009). CTdatabase: a knowledge-base of high-throughput and curated data on cancer-testis antigens. *Nucleic Acids Research*, *37*(suppl_1), D816–D819. https://doi.org/10.1093/nar/gkn673

Arai, Y., Y. K., K. Y., F. Q., O. I., S. A., . . . & F. Y. (2018). Time-lapse monitoring of TLR2 ligand internalization with newly developed fluorescent probes. *Organic & Biomolecular Chemistry*, *16*(20), 3824–3830.

Arnittali, M., Rissanou, A. N., & Harmandaris, V. (2019). Structure Of Biomolecules Through Molecular Dynamics Simulations. *Procedia Computer Science*, *156*, 69–78. https://doi.org/10.1016/j.procs.2019.08.181

Arslan, C., Dizdar, O., & Altundag, K. (2009). Pharmacotherapy of triple-negative breast cancer. *Expert Opinion on Pharmacotherapy*, *10*(13), 2081–2093. https://doi.org/10.1517/14656560903117309

Ayyagari, V. S., T. C., V., K., A. P., & Srirama, K. (2022). Design of a multi-epitope-based vaccine targeting M-protein of SARS-CoV2: an immunoinformatics approach. *Journal of Biomolecular Structure and Dynamics*, *40*(7), 2963–2977. https://doi.org/10.1080/07391102.2020.1850357

UNIVERSITAS
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Badovinac Črnjević, T., Spagnoli, G., Juretić, A., Jakić-Razumović, J., Podolski, P., & Šarić, N. (2012). High expression of MAGE-A10 cancer-testis antigen in triple-negative breast cancer. *Medical Oncology (Northwood, London, England)*, *29*(3), 1586–1591. https://doi.org/10.1007/s12032-011-0120-9

Badve, S., Dabbs, D. J., Schnitt, S. J., Baehner, F. L., Decker, T., Eusebi, V., Fox, S. B., Ichihara, S., Jacquemier, J., Lakhani, S. R., Palacios, J., Rakha, E. A., Richardson, A. L., Schmitt, F. C., Tan, P.-H., Tse, G. M., Weigelt, B., Ellis, I. O., & Reis-Filho, J. S. (2011). Basal-like and triple-negative breast cancers: a critical review with an emphasis on the implications for pathologists and oncologists. *Modern Pathology*, *24*(2), 157–167. https://doi.org/10.1038/modpathol.2010.200

Bahrami, A. A., Payandeh, Z., Khalili, S., Zakeri, A., & Bandehpour, M. (2019). Immunoinformatics: In Silico Approaches and Computational Design of a Multi-epitope, Immunogenic Protein. *International Reviews of Immunology*, *38*(6), 307–322. https://doi.org/10.1080/08830185.2019.1657426

Berner, V., Liu, H., Zhou, Q., Alderson, K. L., Sun, K., Weiss, J. M., Back, T. C., Longo, D. L., Blazar, B. R., Wiltrout, R. H., Welniak, L. A., Redelman, D., & Murphy, W. J. (2007). IFN-γ mediates CD4+ T-cell loss and impairs secondary antitumor responses after successful initial immunotherapy. *Nature Medicine*, *13*(3), 354–360. https://doi.org/10.1038/nm1554

Bezu, L., Kepp, O., Cerrato, G., Pol, J., Fucikova, J., Spisek, R., Zitvogel, L., Kroemer, G., & Galluzzi, L. (2018). Trial watch: Peptide-based vaccines in anticancer therapy. *OncoImmunology*, *7*(12), e1511506. https://doi.org/10.1080/2162402X.2018.1511506

Bianchini, G., De Angelis, C., Licata, L., & Gianni, L. (2022). Treatment landscape of triple-negative breast cancer — expanded options, evolving needs. *Nature Reviews Clinical Oncology*, *19*(2), 91–113. https://doi.org/10.1038/s41571-021-00565-2

Botos, I., Segal, D. M., & Davies, D. R. (2011). The structural biology of Toll-like receptors. *Structure (London, England: 1993)*, *19*(4), 447–459. https://doi.org/10.1016/j.str.2011.02.004

Bowie, J. U., Lüthy, R., & Eisenberg, D. (1991). A method to identify protein sequences that fold into a known three-dimensional structure. *Science (New York, N.Y.)*, *253*(5016), 164–170. https://doi.org/10.1126/science.1853201

Buchan, D. W. A., Minneci, F., Nugent, T. C. O., Bryson, K., & Jones, D. T. (2013). Scalable web services for the PSIPRED Protein Analysis Workbench. *Nucleic Acids Research*, *41*(Web Server issue), W349-57. https://doi.org/10.1093/nar/gkt381

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Bui, H.-H., Sidney, J., Dinh, K., Southwood, S., Newman, M. J., & Sette, A. (2006). Predicting population coverage of T-cell epitope-based diagnostics and vaccines. *BMC Bioinformatics*, *7*, 153. https://doi.org/10.1186/1471-2105-7-153

Caballero, O. L., & Chen, Y.-T. (2009). Cancer/testis (CT) antigens: potential targets for immunotherapy. *Cancer Science*, *100*(11), 2014–2021. https://doi.org/10.1111/j.1349-7006.2009.01303.x

Calvo Tardón, M., Allard, M., Dutoit, V., Dietrich, P.-Y., & Walker, P. R. (2019). Peptides as cancer vaccines. *Current Opinion in Pharmacology*, *47*, 20–26. https://doi.org/https://doi.org/10.1016/j.coph.2019.01.007

Cardoso, W. B., & Mendanha, S. A. (2021). Molecular dynamics simulation of docking structures of SARS-CoV-2 main protease and HIV protease inhibitors. *Journal of Molecular Structure*, *1225*, 129143. https://doi.org/10.1016/j.molstruc.2020.129143

Carugo, O., & Pongor, S. (2001). A normalized root-mean-spuare distance for comparing protein three-dimensional structures. *Protein Science*, *10*(7), 1470–1473. https://doi.org/10.1110/ps.690101

Chen, Y. T., Scanlan, M. J., Sahin, U., Türeci, O., Gure, A. O., Tsang, S., Williamson, B., Stockert, E., Pfreundschuh, M., & Old, L. J. (1997). A testicular antigen aberrantly expressed in human cancers detected by autologous antibody screening. *Proceedings of the National Academy of Sciences of the United States of America*, *94*(5), 1914–1918. https://doi.org/10.1073/pnas.94.5.1914

Chomez, P., De Backer, O., Bertrand, M., De Plaen, E., Boon, T., & Lucas, S. (2001). An overview of the MAGE gene family with the identification of all human members of the family. *Cancer Research*, *61*(14), 5544–5551.

Cob-Calan, N. N., Chi-Uluac, L. A., Ortiz-Chi, F., Cerqueda-García, D., Navarrete-Vázquez, G., Ruiz-Sánchez, E., & Hernández-Núñez, E. (2019). Molecular Docking and Dynamics Simulation of Protein β-Tubulin and Antifungal Cyclic Lipopeptides. *Molecules*, *24*(18), 3387. https://doi.org/10.3390/molecules24183387

Colovos, C., & Yeates, T. O. (1993). Verification of protein structures: patterns of nonbonded atomic interactions. *Protein Science: A Publication of the Protein Society*, *2*(9), 1511–1519. https://doi.org/10.1002/pro.5560020916

Consortium, T. U. (2023). UniProt: the Universal Protein Knowledgebase in 2023. *Nucleic Acids Research*, *51*(D1), D523–D531. https://doi.org/10.1093/nar/gkac1052

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Curigliano, G., Viale, G., Ghioni, M., Jungbluth, A. A., Bagnardi, V., Spagnoli, G. C., Neville, A. M., Nolè, F., Rotmensz, N., & Goldhirsch, A. (2011a). Cancer-testis antigen expression in triple-negative breast cancer. *Annals of Oncology: Official Journal of the European Society for Medical Oncology*, *22*(1), 98–103. https://doi.org/10.1093/annonc/mdq325

Curigliano, G., Viale, G., Ghioni, M., Jungbluth, A. A., Bagnardi, V., Spagnoli, G. C., Neville, A. M., Nolè, F., Rotmensz, N., & Goldhirsch, A. (2011b). Cancer-testis antigen expression in triple-negative breast cancer. *Annals of Oncology: Official Journal of the European Society for Medical Oncology*, *22*(1), 98–103. https://doi.org/10.1093/annonc/mdq325

Dariushnejad, H., Ghorbanzadeh, V., Akbari, S., & Hashemzadeh, P. (2022). Design of a Novel Recombinant Multi-Epitope Vaccine against Triple-Negative Breast Cancer. *Iranian Biomedical Journal*, *26*(2), 160–174. https://doi.org/10.52547/ibj.26.2.160

De Laurentiis, M., Cianniello, D., Caputo, R., Stanzione, B., Arpino, G., Cinieri, S., Lorusso, V., & De Placido, S. (2010). Treatment of triple negative breast cancer (TNBC): current options and future perspectives. *Cancer Treatment Reviews*, *36 Suppl 3*, S80-6. https://doi.org/10.1016/S0305-7372(10)70025-6

De Plaen, E., Arden, K., Traversari, C., Gaforio, J. J., Szikora, J. P., De Smet, C., Brasseur, F., van der Bruggen, P., Lethé, B., & Lurquin, C. (1994). Structure, chromosomal localization, and expression of 12 genes of the MAGE family. *Immunogenetics*, *40*(5), 360–369. https://doi.org/10.1007/BF01246677

Dent, R., Trudeau, M., Pritchard, K. I., Hanna, W. M., Kahn, H. K., Sawka, C. A., Lickley, L. A., Rawlinson, E., Sun, P., & Narod, S. A. (2007). Triple-negative breast cancer: clinical features and patterns of recurrence. *Clinical Cancer Research: An Official Journal of the American Association for Cancer Research*, *13*(15 Pt 1), 4429–4434. https://doi.org/10.1158/1078-0432.CCR-06-3045

Desta, I. T., Porter, K. A., Xia, B., Kozakov, D., & Vajda, S. (2020). Performance and Its Limits in Rigid Body Protein-Protein Docking. *Structure*, *28*(9), 1071-1081.e3. https://doi.org/10.1016/j.str.2020.06.006

Dhanda, S. K., Usmani, S. S., Agrawal, P., Nagpal, G., Gautam, A., & Raghava, G. P. S. (2016). Novel in silico tools for designing peptide-based subunit vaccines and immunotherapeutics. *Briefings in Bioinformatics*, *18*(3), 467–478. https://doi.org/10.1093/bib/bbw025

Dhanda, S. K., Vir, P., & Raghava, G. P. S. (2013). Designing of interferon-gamma inducing MHC class-II binders. *Biology Direct*, *8*, 30. https://doi.org/10.1186/1745-6150-8-30

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Di Lorenzo, A., Bolli, E., Tarone, L., Cavallo, F., & Conti, L. (2020). Toll-Like Receptor 2 at the Crossroad between Cancer Cells, the Immune System, and the Microbiota. In *International Journal of Molecular Sciences* (Vol. 21, Issue 24). https://doi.org/10.3390/ijms21249418

Diez-Rivero, C., & Reche, P. (2010). Discovery of Conserved Epitopes Through Sequence Variability Analyses. *Bioinformatics for Immunomics*. https://doi.org/10.1007/978-1-4419-0540-6_8

Dimitrov, I., Bangov, I., Flower, D. R., & Doytchinova, I. (2014). AllerTOP v.2--a server for in silico prediction of allergens. *Journal of Molecular Modeling*, *20*(6), 2278. https://doi.org/10.1007/s00894-014-2278-5

Donninger, H., Li, C., Eaton, J. W., & Yaddanapudi, K. (2021). Cancer Vaccines: Promising Therapeutics or an Unattainable Dream. *Vaccines*, *9*(6). https://doi.org/10.3390/vaccines9060668

Doytchinova, I. A., & Flower, D. R. (2007). VaxiJen: a server for prediction of protective antigens, tumour antigens and subunit vaccines. *BMC Bioinformatics*, *8*, 4. https://doi.org/10.1186/1471-2105-8-4

Esmaeili, R., Majidzadeh-A, K., Farahmand, L., Ghasemi, M., Salehi, M., & Khoshdel, A. (2015). AKAP3 correlates with triple negative status and disease-free survival in breast cancer. *BMC Cancer*, *15*, 681. https://doi.org/10.1186/s12885-015-1668-0

Fiszer, D., & Kurpisz, M. (1998). Major histocompatibility complex expression on human, male germ cells: a review. *American Journal of Reproductive Immunology (New York, N.Y.: 1989)*, *40*(3), 172–176. https://doi.org/10.1111/j.1600-0897.1998.tb00409.x

Fiszer, D., Ulbrecht, M., Fernandez, N., Johnson, J. P., Weiss, E. H., & Kurpisz, M. (1997). Analysis of HLA class Ib gene expression in male gametogenic cells. *European Journal of Immunology*, *27*(7), 1691–1695. https://doi.org/10.1002/eji.1830270715

Fonseca, J. A., Cabrera-Mora, M., Singh, B., Oliveira-Ferreira, J., da Costa Lima-Junior, J., Calvo-Calle, J. M., Lozano, J. M., & Moreno, A. (2016). A chimeric protein-based malaria vaccine candidate induces robust T cell responses against Plasmodium vivax MSP119. *Scientific Reports*, *6*(1), 34527. https://doi.org/10.1038/srep34527

Gasteiger, E., Hoogland, C., Gattiker, A., Duvaud, S., Wilkins, M. R., Appel, R. D., & Bairoch, A. (2005). *Protein Identification and Analysis Tools on the ExPASy Server BT - The Proteomics Protocols Handbook* (J. M. Walker, Ed.; pp. 571–607). Humana Press. https://doi.org/10.1385/1-59259-890-0:571

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Gaugler, B., Van den Eynde, B., van der Bruggen, P., Romero, P., Gaforio, J. J., De Plaen, E., Lethé, B., Brasseur, F., & Boon, T. (1994). Human gene MAGE-3 codes for an antigen recognized on a melanoma by autologous cytolytic T lymphocytes. *The Journal of Experimental Medicine*, *179*(3), 921–930. https://doi.org/10.1084/jem.179.3.921

Ghahremanian, S., Rashidi, M. M., Raeisi, K., & Toghraie, D. (2022). Molecular dynamics simulation approach for discovering potential inhibitors against SARS-CoV-2: A structural review. *Journal of Molecular Liquids*, *354*, 118901. https://doi.org/10.1016/j.molliq.2022.118901

Gibbs, Z. A., & Whitehurst, A. W. (2018). Emerging Contributions of Cancer/Testis Antigens to Neoplastic Behaviors. *Trends in Cancer*, *4*(10), 701–712. https://doi.org/https://doi.org/10.1016/j.trecan.2018.08.005

Gluz, O., Liedtke, C., Gottschalk, N., Pusztai, L., Nitz, U., & Harbeck, N. (2009). Triple-negative breast cancer--current status and future directions. *Annals of Oncology: Official Journal of the European Society for Medical Oncology*, *20*(12), 1913–1927. https://doi.org/10.1093/annonc/mdp492

Grote, A., Hiller, K., Scheer, M., Münch, R., Nörtemann, B., Hempel, D. C., & Jahn, D. (2005). JCat: a novel tool to adapt codon usage of a target gene to its potential expression host. *Nucleic Acids Research*, *33*(Web Server issue), W526-31. https://doi.org/10.1093/nar/gki376

Gupta, S., Kapoor, P., Chaudhary, K., Gautam, A., Kumar, R., & Raghava, G. P. S. (2013). In silico approach for predicting toxicity of peptides and proteins. *PloS One*, *8*(9), e73957. https://doi.org/10.1371/journal.pone.0073957

Hasegawa, K., Ono, T., Matsushita, H., Shimono, M., Noguchi, Y., Mizutani, Y., Kodama, J., Kudo, T., & Nakayama, E. (2004). A-kinase anchoring protein 3 messenger RNA expression in ovarian cancer and its implication on prognosis. *International Journal of Cancer*, *108*(1), 86–90. https://doi.org/10.1002/ijc.11565

Hassan, M., & Coutsias, E. A. (2021). Protein secondary structure motifs: A kinematic construction. *Journal of Computational Chemistry*, *42*(5), 271–292. https://doi.org/10.1002/jcc.26448

Hollingsworth, R. E., & Jansen, K. (2019). Turning the corner on therapeutic cancer vaccines. *Npj Vaccines*, *4*(1), 7. https://doi.org/10.1038/s41541-019-0103-y

Hung, K., Hayashi, R., Lafond-Walker, A., Lowenstein, C., Pardoll, D., & Levitsky, H. (1998). The Central Role of CD4+ T Cells in the Antitumor Immune Response. *Journal of Experimental Medicine*, *188*(12), 2357–2368. https://doi.org/10.1084/jem.188.12.2357

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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Ikai, A. (1980). Thermostability and aliphatic index of globular proteins. *Journal of Biochemistry*, *88*(6), 1895–1898.

Imatdinov, A., Kazakova, A., Sekler, M., Yu, D., Lyska, V., Ilya, T., Sevskikh, T., & Sereda, A. (2020). Immunization of Pigs with Recombinant Plasmids Containing Genes of Ubiquitinated p30, p54 and CD2v Proteins of African Swine Fever Virus. *Acta Veterinaria*, *70*, 92–109. https://doi.org/10.2478/acve-2020-0007

International Agency for Research on Cancer. (2020). *Indonesia*. https://gco.iarc.fr/today/data/factsheets/populations/360-indonesia-fact-sheets.pdf

Iqbal, J., Ginsburg, O., Rochon, P., Sun, P., & Narod, S. (2015). Differences in Breast Cancer Stage at Diagnosis and Cancer-Specific Survival by Race and Ethnicity in the United States. *JAMA*, *313*, 165–173. https://doi.org/10.1001/jama.2014.17322

Jiang, Z., You, L., Dou, W., Sun, T., & Xu, P. (2019). Effects of an Electric Field on the Conformational Transition of the Protein: A Molecular Dynamics Simulation Study. *Polymers*, *11*(2), 282. https://doi.org/10.3390/polym11020282

Kagan, J. C., Su, T., Horng, T., Chow, A., Akira, S., & Medzhitov, R. (2008). TRAM couples' endocytosis of Toll-like receptor 4 to the induction of interferon-β. *Nature Immunology*, *9*(4), 361–368. https://doi.org/10.1038/ni1569

Kao, D. J., & Hodges, R. S. (2009). Advantages of a Synthetic Peptide Immunogen Over a Protein Immunogen in the Development of an Anti-Pilus Vaccine for Pseudomonas aeruginosa. *Chemical Biology & Drug Design*, *74*(1), 33–42. https://doi.org/https://doi.org/10.1111/j.1747-0285.2009.00825.x

Khan, S., Fakhar, Z., Hussain, A., Ahmad, A., Jairajpuri, D. S., Alajmi, M. F., & Hassan, Md. I. (2022). Structure-based identification of potential SARS-CoV-2 main protease inhibitors. *Journal of Biomolecular Structure and Dynamics*, *40*(8), 3595–3608. https://doi.org/10.1080/07391102.2020.1848634

Ko, J., Park, H., Heo, L., & Seok, C. (2012). GalaxyWEB server for protein structure prediction and refinement. *Nucleic Acids Research*, *40*(W1), W294–W297. https://doi.org/10.1093/nar/gks493

Kollnberger, S. D., Gutierrez-Castañeda, B., Foster-Cuevas, M., Corteyn, A., & Parkhouse, R. M. E. (2002). Identification of the principal serological immunodeterminants of African swine fever virus by screening a virus cDNA library with antibody. *The Journal of General Virology*, *83*(Pt 6), 1331–1342. https://doi.org/10.1099/0022-1317-83-6-1331

UNIVERSITAS
GADJAH MADA
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Kozakov, D., Hall, D. R., Xia, B., Porter, K. A., Padhorny, D., Yueh, C., Beglov, D., & Vajda, S. (2017). The ClusPro web server for protein-protein docking. *Nature Protocols*, *12*(2), 255–278. https://doi.org/10.1038/nprot.2016.169

Krishnamoorthy, H. R., & Karuppasamy, R. (2023a). Design and In Silico Validation of a Novel MZF-1-Based Multi-Epitope Vaccine to Combat Metastatic Triple Negative Breast Cancer. *Vaccines*, *11*(3). https://doi.org/10.3390/vaccines11030577

Krishnamoorthy, H. R., & Karuppasamy, R. (2023b). Designing a novel SOX9 based multi-epitope vaccine to combat metastatic triple-negative breast cancer using immunoinformatics approach. *Molecular Diversity*, *27*(4), 1829–1842. https://doi.org/10.1007/s11030-022-10539-w

Kuhlman, B., & Bradley, P. (2019). Advances in protein structure prediction and design. *Nature Reviews Molecular Cell Biology*, *20*(11), 681–697. https://doi.org/10.1038/s41580-019-0163-x

Kumar, S., Shuaib, M., Prajapati, K. S., Singh, A. K., Choudhary, P., Singh, S., & Gupta, S. (2022). A candidate triple-negative breast cancer vaccine design by targeting clinically relevant cell surface markers: an integrated immuno and bio-informatics approach. *3 Biotech*, *12*(3), 1–20. https://doi.org/10.1007/s13205-022-03140-3

Kyte, J., & Doolittle, R. F. (1982). A simple method for displaying the hydropathic character of a protein. *Journal of Molecular Biology*, *157*(1), 105–132. https://doi.org/10.1016/0022-2836(82)90515-0

Lam, R. A., Tien, T. Z., Joseph, C. R., Lim, J. X., Thike, A. A., Iqbal, J., Tan, P. H., & Yeong, J. P. S. (2021). Cancer-Testis Antigens in Triple-Negative Breast Cancer: Role and Potential Utility in Clinical Practice. *Cancers*, *13*(15). https://doi.org/10.3390/cancers13153875

Larsen, M. V, Lundegaard, C., Lamberth, K., Buus, S., Lund, O., & Nielsen, M. (2007). Large-scale validation of methods for cytotoxic T-lymphocyte epitope prediction. *BMC Bioinformatics*, *8*, 424. https://doi.org/10.1186/1471-2105-8-424

Laskowski, R. A., Jabłońska, J., Pravda, L., Vařeková, R. S., & Thornton, J. M. (2018). PDBsum: Structural summaries of PDB entries. *Protein Science: A Publication of the Protein Society*, *27*(1), 129–134. https://doi.org/10.1002/pro.3289

Laskowski, R., Macarthur, M. W., Moss, D. S., & Thornton, J. (1993). PROCHECK: A program to check the stereochemical quality of protein structures. *Journal of Applied Crystallography*, *26*, 283–291. https://doi.org/10.1107/S0021889892009944

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Le, D. T., Pardoll, D. M., & Jaffee, E. M. (2010). Cellular Vaccine Approaches. *The Cancer Journal*, *16*(4).

Lee, H. J., Kim, J. Y., Song, I. H., Park, I. A., Yu, J. H., & Gong, G. (2015). Expression of NY-ESO-1 in Triple-Negative Breast Cancer Is Associated with Tumor-Infiltrating Lymphocytes and a Good Prognosis. *Oncology*, *89*(6), 337–344. https://doi.org/10.1159/000439535

Lee, S. J., Shin, S. J., Lee, M. H., Lee, M.-G., Kang, T. H., Park, W. S., Soh, B. Y., Park, J. H., Shin, Y. K., Kim, H. W., Yun, C.-H., Jung, I. D., & Park, Y.-M. (2014). A Potential Protein Adjuvant Derived from Mycobacterium tuberculosis Rv0652 Enhances Dendritic Cells-Based Tumor Immunotherapy. *PLoS ONE*, *9*(8), e104351. https://doi.org/10.1371/journal.pone.0104351

Lee, W.-J., Jo, J.-H., Uwamahoro, C., Jang, S.-I., Jung, E.-J., Bae, J.-W., Moon, J., Kim, D.-H., Yi, J. K., Ha, J. J., Oh, D. Y., & Kwon, W.-S. (2025). Role of PI3K/AKT signaling pathway during capacitation. *Theriogenology*, *235*, 94–102. https://doi.org/10.1016/j.theriogenology.2024.12.026

Li, X., Guo, L., Kong, M., Su, X., Yang, D., Zou, M., Liu, Y., & Lu, L. (2016). Design and Evaluation of a Multi-Epitope Peptide of Human Metapneumovirus. *Intervirology*, *58*(6), 403–412. https://doi.org/10.1159/000445059

Li, Y., Li, J., Wang, Y., Zhang, Y., Chu, J., Sun, C., Fu, Z., Huang, Y., Zhang, H., Yuan, H., & Yin, Y. (2017). Roles of cancer/testis antigens (CTAs) in breast cancer. *Cancer Letters*, *399*, 64–73. https://doi.org/https://doi.org/10.1016/j.canlet.2017.02.031

Livingston, B., Crimi, C., Newman, M., Higashimot, Y., Appella, E., Sidney, J., & Sette, A. (2002). A rational strategy to design multiepitope immunogens based on multiple Th lymphocyte epitopes. *J Immunol*, *168*(11), 5499–5506.

Lüthy, R., Bowie, J. U., & Eisenberg, D. (1992). Assessment of protein models with three-dimensional profiles. *Nature*, *356*(6364), 83–85. https://doi.org/10.1038/356083a0

Mahapatra, S. R., Dey, J., Raj, T. K., Misra, N., & Suar, M. (2023). Designing a Next-Generation Multiepitope-Based Vaccine against Staphylococcus aureus Using Reverse Vaccinology Approaches. *Pathogens (Basel, Switzerland)*, *12*(3). https://doi.org/10.3390/pathogens12030376

Mahdevar, E., Safavi, A., Abiri, A., Kefayat, A., Hejazi, S. H., Miresmaeili, S. M., & Iranpur Mobarakeh, V. (2022). Exploring the cancer-testis antigen BORIS to design a novel multi-epitope vaccine against breast cancer based on immunoinformatics approaches. *Journal of Biomolecular Structure and*

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Dynamics, *40*(14), 6363–6380. https://doi.org/10.1080/07391102.2021.1883111

Mai, C. W., Kang, Y. B., & Pichika, M. R. (2013). Should a Toll-like receptor 4 (TLR-4) agonist or antagonist be designed to treat cancer? TLR-4: its expression and effects in the ten most common cancers. *OncoTargets and Therapy*, *6*, 1573–1587. https://doi.org/10.2147/OTT.S50838

Martín-Villa, J. M., Luque, I., Martínez-Quiles, N., Corell, A., Regueiro, J. R., Timón, M., & Arnaiz-Villena, A. (1996). Diploid expression of human leukocyte antigen class I and class II molecules on spermatozoa and their cyclic inverse correlation with inhibin concentration. *Biology of Reproduction*, *55*(3), 620–629. https://doi.org/10.1095/biolreprod55.3.620

Maxfield, K., Taus, P. J., Corcoran, K., Wooten, J. S., Macion, J., Zhou, Y., Borromeo, M. D., Kollipara, R. K., Yan, J., Xie, Y., Xie, X.-J., & Whitehurst, A. W. (2015). Comprehensive functional characterization of cancer–testis antigens define obligate participation in multiple hallmarks of cancer. *Nature Communications*, *6*.

Morris, G. M., & Lim-Wilby, M. (2008). Molecular docking. *Methods in Molecular Biology (Clifton, N.J.)*, *443*, 365–382. https://doi.org/10.1007/978-1-59745-177-2_19

Nandy, A., & Basak, S. C. (2019). Bioinformatics in Design of Antiviral Vaccines. In *Encyclopedia of Biomedical Engineering* (pp. 280–290). https://doi.org/10.1016/B978-0-12-801238-3.10878-5

National Cancer Institute. (2019). *Immunotherapy to Treat Cancer*. https://www.cancer.gov/about-cancer/treatment/types/immunotherapy

(NCI), N. C. I. (Ed.). (2016). *Double Blind, Parallel Groups, Controlled, Randomized Phase II Trial to Evaluate Vaccination with Folate Receptor Alpha Peptide Vaccine With GM-CSF as Vaccine Adjuvant Following Oral Cyclophosphamide Versus GM-CSF/Placebo to Prevent Recurrence in Patients*.

(NCI), N. C. I. (Ed.). (2019). *Phase II Trial to Evaluate Immune-Related Biomarkers for Pathological Response in Stage II-III HER2-Positive Breast Cancer Receiving Neoadjuvant Chemotherapy with Subsequent Randomization to Multi-Epitope HER2 Vaccine vs. Placebo in Patients with Residual*.

Nordin, M. L., Azemi, A. K., Nordin, A. H., Nabgan, W., Ng, P. Y., Yusoff, K., Abu, N., Lim, K. P., Zakaria, Z. A., Ismail, N., & Azmi, F. (2023). Peptide-Based Vaccine against Breast Cancer: Recent Advances and Prospects. *Pharmaceuticals*, *16*(7). https://doi.org/10.3390/ph16070923

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Nowell, P. C. (1976). The clonal evolution of tumor cell populations. *Science (New York, N.Y.)*, *194*(4260), 23–28. https://doi.org/10.1126/science.959840

Ohashi, K., Saji, F., Kato, M., Wakimoto, A., & Tanizawa, O. (1990). HLA expression on human ejaculated sperm. *American Journal of Reproductive Immunology (New York, N.Y.: 1989)*, *23*(1), 29–32. https://doi.org/10.1111/j.1600-0897.1990.tb00665.x

Orosco, F., & Espiritu, L. (2024). Navigating the landscape of adjuvants for subunit vaccines: recent advances and future perspectives. *International Journal of Applied Pharmaceutics*, 18–32. https://doi.org/10.22159/ijap.2024v16i1.49563

Pal, S. K., & Mortimer, J. (2009). Triple-negative breast cancer: novel therapies and new directions. *Maturitas*, *63*(4), 269–274. https://doi.org/10.1016/j.maturitas.2009.06.010

Paranthaman, P., & Veerappapillai, S. (2023). Design of a potential Sema4A-based multi-epitope vaccine to combat triple-negative breast cancer: an immunoinformatic approach. *Medical Oncology*, *40*(3), 105. https://doi.org/10.1007/s12032-023-01970-6

Parida, P. K., Paul, D., & Chakravorty, D. (2020). The natural way forward: Molecular dynamics simulation analysis of phytochemicals from Indian medicinal plants as potential inhibitors of <scp>SARS-CoV</scp> -2 targets. *Phytotherapy Research*, *34*(12), 3420–3433. https://doi.org/10.1002/ptr.6868

Parvizpour, S., Pourseif, M. M., Razmara, J., Rafi, M. A., & Omidi, Y. (2020). Epitope-based vaccine design: a comprehensive overview of bioinformatics approaches. *Drug Discovery Today*, *25*(6), 1034–1042. https://doi.org/https://doi.org/10.1016/j.drudis.2020.03.006

Parvizpour, S., Razmara, J., Pourseif, M., & Omidi, Y. (2019). In silico design of a triple-negative breast cancer vaccine by targeting cancer testis antigens. *BioImpacts*, *9*, 45–56. https://doi.org/10.15171/bi.2019.06

Ponomarenko, J., Bui, H.-H., Li, W., Fusseder, N., Bourne, P. E., Sette, A., & Peters, B. (2008). ElliPro: a new structure-based tool for the prediction of antibody epitopes. *BMC Bioinformatics*, *9*, 514. https://doi.org/10.1186/1471-2105-9-514

Porter, K. A., Xia, B., Beglov, D., Bohnuud, T., Alam, N., Schueler-Furman, O., & Kozakov, D. (2017). ClusPro PeptiDock: efficient global docking of peptide recognition motifs using FFT. *Bioinformatics (Oxford, England)*, *33*(20), 3299–3301. https://doi.org/10.1093/bioinformatics/btx216

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Prawiningrum, A. F., Paramita, R. I., & Panigoro, S. S. (2022). Immunoinformatics Approach for Epitope-Based Vaccine Design: Key Steps for Breast Cancer Vaccine. *Diagnostics (Basel, Switzerland)*, *12*(12). https://doi.org/10.3390/diagnostics12122981

Rapin, N., Lund, O., Bernaschi, M., & Castiglione, F. (2010). Computational Immunology Meets Bioinformatics: The Use of Prediction Tools for Molecular Binding in the Simulation of the Immune System. *PLOS ONE*, *5*(4), e9862.

Reya, T., Morrison, S. J., Clarke, M. F., & Weissman, I. L. (2001). Stem cells, cancer, and cancer stem cells. *Nature*, *414*(6859), 105–111. https://doi.org/10.1038/35102167

Reynisson, B., Barra, C., Kaabinejadian, S., Hildebrand, W. H., Peters, B., & Nielsen, M. (2020). Improved Prediction of MHC II Antigen Presentation through Integration and Motif Deconvolution of Mass Spectrometry MHC Eluted Ligand Data. *Journal of Proteome Research*, *19*(6), 2304–2315. https://doi.org/10.1021/acs.jproteome.9b00874

Rodrigues, T. C. V., Jaiswal, A. K., Sarom, A. de, Oliveira, L. de C., Oliveira, Carlo José Freire Ghosh, P., Tiwari, S., Miranda, F. M., Benevides, L. de J., Azevedo, V. A. de C., & Soares, S. de C. (2019). Reverse vaccinology and subtractive genomics reveal new therapeutic targets against Mycoplasma pneumoniae: a causative agent of pneumonia. *Royal Society Open Science*, *6*(7). https://doi.org/https://doi.org/10.1098/rsos.190907

Rosa, D. S., Ribeiro, S. P., & Cunha-Neto, E. (2010). CD4+ T Cell Epitope Discovery and Rational Vaccine Design. *Archivum Immunologiae et Therapiae Experimentalis*, *58*(2), 121–130. https://doi.org/10.1007/s00005-010-0067-0

Ros-Lucas, A., Correa-Fiz, F., Bosch-Camós, L., Rodriguez, F., & Alonso-Padilla, J. (2020). Computational Analysis of African Swine Fever Virus Protein Space for the Design of an Epitope-Based Vaccine Ensemble. *Pathogens (Basel, Switzerland)*, *9*(12). https://doi.org/10.3390/pathogens9121078

Rousseaux, S., Debernardi, A., Jacquiau, B., Vitte, A.-L., Vesin, A., Nagy-Mignotte, H., Moro-Sibilot, D., Brichon, P.-Y., Lantuejoul, S., Hainaut, P., Laffaire, J., Reyniès, A., Beer, D., Timsit, J.-F., Brambilla, C., Brambilla, E., & Khochbin, S. (2013). Ectopic Activation of Germline and Placental Genes Identifies Aggressive Metastasis-Prone Lung Cancers. *Science Translational Medicine*, *5*, 186ra66. https://doi.org/10.1126/scitranslmed.3005723

Roychowdhury, A., Jondhale, M., Saldanha, E., Ghosh, D., Kumar Panda, C., Chandrani, P., & Mukherjee, N. (2021). Landscape of toll-like receptors

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

expression in tumor microenvironment of triple negative breast cancer (TNBC): Distinct roles of TLR4 and TLR8. *Gene*, *792*, 145728. https://doi.org/10.1016/j.gene.2021.145728

Safavi, A., Kefayat, A., Mahdevar, E., Ghahremani, F., Nezafat, N., & Modarressi, M. H. (2021). Efficacy of co-immunization with the DNA and peptide vaccines containing SYCP1 and ACRBP epitopes in a murine triple-negative breast cancer model. *Human Vaccines & Immunotherapeutics*, *17*(1), 22–34. https://doi.org/10.1080/21645515.2020.1763693

Safavi, A., Kefayat, Amirhosein Sotoodehnejadnematalahi, F., Salehi, M., & Modarress, M. H. (2019). In Silico Analysis of Synaptonemal Complex Protein 1 (SYCP1) and Acrosin Binding Protein (ACRBP) Antigens to Design Novel Multiepitope Peptide Cancer Vaccine Against Breast Cancer. *International Journal of Peptide Research and Therapeutics*, *25*. https://doi.org/10.1007/s10989-018-9780-z

Saghapour E, S. M. (2019). Physicochemical Position-Dependent Properties in the Protein Secondary Structures. *Iran Biomed J*, *23*(4), 253–261.

Saha, S., & Raghava, G. P. S. (2006). Prediction of continuous B-cell epitopes in an antigen using recurrent neural network. *Proteins*, *65*(1), 40–48. https://doi.org/10.1002/prot.21078

Scanlan, M. J., Simpson, A. J. G., & Old, L. J. (2004). The cancer/testis genes: review, standardization, and commentary. *Cancer Immunity*, *4*, 1.

Seder, R. A., & Mascola, J. R. (2003). Immunology. In P. H. Bloom, B.R., Lambert (Ed.), *The vaccine book* (Bloom, B.R, pp. 51–72). Academic.

Sharma, A., Campbell, M., Yee, C., Goswami, S., & Sharma, P. (2019). *77 - Immunotherapy of Cancer* (R. R. Rich, T. A. Fleisher, W. T. Shearer, H. W. Schroeder, A. J. Frew, & C. M. B. T.-C. I. (Fifth E. Weyand, Eds.; pp. 1033-1048.e1). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-7020-6896-6.00077-6

Shey, R. A., Ghogomu, S. M., Esoh, K. K., Nebangwa, N. D., Shintouo, C. M., Nongley, N. F., Asa, B. F., Ngale, F. N., Vanhamme, L., & Souopgui, J. (2019). In-silico design of a multi-epitope vaccine candidate against onchocerciasis and related filarial diseases. *Scientific Reports*, *9*(1), 4409. https://doi.org/10.1038/s41598-019-40833-x

Shi, S., Xu, C., Fang, X., Zhang, Y., Li, H., Wen, W., & Yang, G. (2020). Expression profile of Toll-like receptors in human breast cancer. *Molecular Medicine Reports*, *21*(2), 786–794. https://doi.org/10.3892/mmr.2019.10853

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Silva, M. F., Pereira, G., Mateus, L., da Costa, L. L., & Silva, E. (2024). Design of a multi-epitope-based vaccine candidate against Bovine Genital Campylobacteriosis using a reverse vaccinology approach. *BMC Veterinary Research*, *20*(1), 144. https://doi.org/10.1186/s12917-024-04006-x

Silva, V., Fonseca, A., Fonsêca, M., Silva, T., Coelho, A., Kroll, J., Souza, J., Stransky, B., de Souza, G., & Souza, S. (2017). Genome-wide identification of cancer/testis genes and their association with prognosis in a pan-cancer analysis. *Oncotarget*, *8*. https://doi.org/10.18632/oncotarget.21715

Simpson, A. J. G., Caballero, O. L., Jungbluth, A., Chen, Y.-T., & Old, L. J. (2005). Cancer/testis antigens, gametogenesis and cancer. *Nature Reviews. Cancer*, *5*(8), 615–625. https://doi.org/10.1038/nrc1669

Sira, E. M. J. S., Banico, E. C., Fajardo, L. E., Odchimar, N. M. O., Simbulan, A. M., & Orosco, F. L. (2024). Current strategies, advances, and challenges in multi-epitope subunit vaccine development for African swine fever virus: https://doi.org/10.12982/VIS.2025.011. *Veterinary Integrative Sciences*, *23*(1 SE-Review Article), 1–48.

Slingluff, C. L. J. (2011). The present and future of peptide vaccines for cancer: single or multiple, long or short, alone or in combination? *Cancer Journal (Sudbury, Mass.)*, *17*(5), 343–350. https://doi.org/10.1097/PPO.0b013e318233e5b2

Soriano, J. M., Rico, H., Moltó, J. C., & Mañes, J. (2000). Assessment of the microbiological quality and wash treatments of lettuce served in university restaurants. *International Journal of Food Microbiology*, *58*(1–2), 123–128. https://doi.org/10.1016/s0168-1605(00)00288-9

Sørlie, T., Perou, C. M., Tibshirani, R., Aas, T., Geisler, S., Johnsen, H., Hastie, T., Eisen, M. B., van de Rijn, M., Jeffrey, S. S., Thorsen, T., Quist, H., Matese, J. C., Brown, P. O., Botstein, D., Lønning, P. E., & Børresen-Dale, A. L. (2001). Gene expression patterns of breast carcinomas distinguish tumor subclasses with clinical implications. *Proceedings of the National Academy of Sciences of the United States of America*, *98*(19), 10869–10874. https://doi.org/10.1073/pnas.191367098

T, D., Kamaraj, B., Vasudevan, K., Gopikrishnan, M., K R, D., Rambabu, M., & C, G. P. Doss. (2023). Structural immunoinformatics approach for rational design of a multi-epitope vaccine against triple negative breast cancer. *International Journal of Biological Macromolecules*, *243*, 125209. https://doi.org/https://doi.org/10.1016/j.ijbiomac.2023.125209

Tang, C.-T., Li, P.-C., Liu, I.-J., Liao, M.-Y., Chiu, D.-Y., Chao, C.-Y., & Wu, H.-C. (2015). An Epitope-Substituted DNA Vaccine Improves Safety and

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Immunogenicity against Dengue Virus Type 2. *PLoS Negl Trop Dis*, *9*(7), e0003903.

Tanimura, N., Saitoh, S., Matsumoto, F., Akashi-Takamura, S., & Miyake, K. (2008). Roles for LPS-dependent interaction and relocation of TLR4 and TRAM in TRIF-signaling. *Biochemical and Biophysical Research Communications*, *368*(1), 94–99. https://doi.org/10.1016/j.bbrc.2008.01.061

Thike, A. A., Cheok, P. Y., Jara-Lazaro, A. R., Tan, B., Tan, P., & Tan, P. H. (2010). Triple-negative breast cancer: clinicopathological characteristics and relationship with basal-like breast cancer. *Modern Pathology*, *23*(1), 123–133. https://doi.org/10.1038/modpathol.2009.145

Tripathi, N., Goel, B., Bhardwaj, N., Sahu, B., Kumar, H., & Jain, S. K. (2022). Virtual screening and molecular simulation study of natural products database for lead identification of novel coronavirus main protease inhibitors. *Journal of Biomolecular Structure and Dynamics*, *40*(8), 3655–3667. https://doi.org/10.1080/07391102.2020.1848630

Turajlic, S., Litchfield, K., Xu, H., Rosenthal, R., McGranahan, N., Reading, J. L., Wong, Y. N. S., Rowan, A., Kanu, N., Al Bakir, M., Chambers, T., Salgado, R., Savas, P., Loi, S., Birkbak, N. J., Sansregret, L., Gore, M., Larkin, J., Quezada, S. A., & Swanton, C. (2017). Insertion-and-deletion-derived tumour-specific neoantigens and the immunogenic phenotype: a pan-cancer analysis. *The Lancet Oncology*, *18*(8), 1009–1021. https://doi.org/10.1016/S1470-2045(17)30516-8

Türeci, O., Chen, Y. T., Sahin, U., Güre, A. O., Zwick, C., Villena, C., Tsang, S., Seitz, G., Old, L. J., & Pfreundschuh, M. (1998). Expression of SSX genes in human tumors. *International Journal of Cancer*, *77*(1), 19–23. https://doi.org/10.1002/(sici)1097-0215(19980703)77:1<19: aid-ijc4>3.0.co;2-2

Van Calster, B., Vanden Bempt, I., Drijkoningen, M., Pochet, N., Cheng, J., Van Huffel, S., Hendrickx, W., Decock, J., Huang, H.-J., Leunen, K., Amant, F., Berteloot, P., Paridaens, R., Wildiers, H., Van Limbergen, E., Weltens, C., Timmerman, D., Van Gorp, T., Smeets, A., … Neven, P. (2009). Axillary lymph node status of operable breast cancers by combined steroid receptor and HER-2 status: triple positive tumours are more likely lymph node positive. *Breast Cancer Research and Treatment*, *113*(1), 181–187. https://doi.org/10.1007/s10549-008-9914-7

van der Bruggen, P., Traversari, C., Chomez, P., Lurquin, C., De Plaen, E., Van den Eynde, B., Knuth, A., & Boon, T. (1991). A gene encoding an antigen recognized by cytolytic T lymphocytes on a human melanoma. *Science (New York, N.Y.)*, *254*(5038), 1643–1647. https://doi.org/10.1126/science.1840703

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Van Regenmortel, M. H. V. (2001). Antigenicity and Immunogenicity of Synthetic Peptides. *Biologicals*, *29*(3), 209–213. https://doi.org/https://doi.org/10.1006/biol.2001.0308

Walker, J. M. Te. (2005). *Proteomics Protocols Handbook*. Springer.

Wan, Y. Y., & Flavell, R. A. (2009). How diverse--CD4 effector T cells and their functions. *Journal of Molecular Cell Biology*, *1*(1), 20–36. https://doi.org/10.1093/jmcb/mjp001

WHO. (2023). *Breast Cancer*. https://www.who.int/news-room/fact-sheets/detail/breast-cancer#:~:text=In 2020%2C there were 2.3, the world's most prevalent cancer.

Wieczorek, M., Abualrous, E. T., Sticht, J., Álvaro-Benito, M., Stolzenberg, S., Noé, F., & Freund, C. (2017). Major Histocompatibility Complex (MHC) Class I and MHC Class II Proteins: Conformational Plasticity in Antigen Presentation. *Frontiers in Immunology*, *8*, 292. https://doi.org/10.3389/fimmu.2017.00292

Wui, S. R., Ko, A., Ryu, J. I., Sim, E., Lim, S. J., Park, S. A., Kim, K. S., Kim, H., Youn, H., & Lee, N. G. (2021). The Effect of a TLR4 Agonist/Cationic Liposome Adjuvant on Varicella-Zoster Virus Glycoprotein E Vaccine Efficacy: Antigen Presentation, Uptake, and Delivery to Lymph Nodes. *Pharmaceutics*, *13*(3), 390. https://doi.org/10.3390/pharmaceutics13030390

Yaddanapudi, K., Mitchell, R. A., & Eaton, J. W. (2013). Cancer vaccines: Looking to the future. *Oncoimmunology*, *2*(3), e23403. https://doi.org/10.4161/onci.23403

Yang, J., & Zhang, Y. (2015). I-TASSER server: new development for protein structure and function predictions. *Nucleic Acids Research*, *43*(W1), W174–W181. https://doi.org/10.1093/nar/gkv342

Yin, L., Duan, J.-J., Bian, X.-W., & Yu, S. (2020). Triple-negative breast cancer molecular subtyping and treatment progress. *Breast Cancer Research*, *22*(1), 61. https://doi.org/10.1186/s13058-020-01296-5

Zanoni, I., Ostuni, R., Marek, L. R., Barresi, S., Barbalat, R., Barton, G. M., Granucci, F., & Kagan, J. C. (2011). CD14 Controls the LPS-Induced Endocytosis of Toll-like Receptor 4. *Cell*, *147*(4), 868–880. https://doi.org/10.1016/j.cell.2011.09.051

Zendman, A. J. W., Ruiter, D. J., & Van Muijen, G. N. P. (2003). Cancer/testis-associated genes: identification, expression profile, and putative function. *Journal of Cellular Physiology*, *194*(3), 272–288. https://doi.org/10.1002/jcp.10215

UNIVERSITAS
GADJAH MADA
Desain Vaksin Basis Multi-Epitope untuk Terapi Triple-Negative Breast Cancer (TNBC) dengan Eksplorasi Antigen A-Kinase Anchoring Protein 3 (AKAP3) menggunakan Pendekatan Bioinformatika
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Zhan, C.-H., Ding, D.-S., Zhang, W., Wang, H.-L., Liu, Z.-Y., & Guo-Jun, M. &. (2022). The cancer-testis antigen a-kinase anchor protein 3 facilitates breast cancer progression via activation of the PTEN/PI3K/AKT/mTOR signaling. *Bioengineered*, *13*(4), 8478–8489. https://doi.org/DOI: 10.1080/21655979.2022.2051687

Zhang, C., Freddolino, P. L., & Zhang, Y. (2017). COFACTOR: improved protein function prediction by combining structure, sequence and protein–protein interaction information. *Nucleic Acids Research*, *45*(W1), W291–W299. https://doi.org/10.1093/nar/gkx366

Zhang, H., Zhao, S., Zhang, H., Qin, Z., Shan, H., & Cai, X. (2023). Vaccines for African swine fever: an update. *Frontiers in Microbiology*, *14*, 1139494. https://doi.org/10.3389/fmicb.2023.1139494

Zheng, W., Zhang, C., Li, Y., Pearce, R., Bell, E. W., & Zhang, Y. (2021). Folding non-homologous proteins by coupling deep-learning contact maps with I-TASSER assembly simulations. *Cell Reports Methods*, *1*(3), 100014. https://doi.org/10.1016/j.crmeth.2021.100014

Zhou, W.-Y., Shi, Y., Wu, C., Zhang, W.-J., Mao, X.-H., Guo, G., Li, H.-X., & Zou, Q.-M. (2009). Therapeutic efficacy of a multi-epitope vaccine against Helicobacter pylori infection in BALB/c mice model. *Vaccine*, *27*(36), 5013–5019. https://doi.org/https://doi.org/10.1016/j.vaccine.2009.05.009

Zhou, X., Zheng, W., Li, Y., Pearce, R., Zhang, C., Bell, E. W., Zhang, G., & Zhang, Y. (2022). I-TASSER-MTD: a deep-learning-based platform for multi-domain protein structure and function prediction. *Nature Protocols*, *17*(10), 2326–2353. https://doi.org/10.1038/s41596-022-00728-0