

## DAFTAR PUSTAKA

- Aghdamifar, E., Sharabiani, V. R., Taghinezhad, E., Szymanek, M., & Dziwulska-Hunek, A. (2023). E-nose as a non-destructive and fast method for identification and classification of coffee beans based on soft computing models. *Sensors and Actuators B: Chemical*, 393(June), 134229. <https://doi.org/10.1016/j.snb.2023.134229>
- Ait Si Ali, A., Djelouat, H., Amira, A., Bensaali, F., Benammar, M., & Bermak, A. (2017). Electronic nose system on the Zynq SoC platform. *Microprocessors and Microsystems*, 53, 145–156. <https://doi.org/10.1016/j.micpro.2017.07.012>
- Aji Lintang, C., Wahyu Widodo, T., & Lelono, D. (2016). Rancang Bangun Electronic Nose untuk Mendeteksi Tingkat Kebusukan Ikan Air Tawar. *Ijeis*, 6(2), 129–140.
- Amkor, A., & Barbri, N. El. (2023). Classification of Potatoes According to Their Cultivated Field by SVM and KNN Approaches Using An Electronic Nose. *Bulletin of Electrical Engineering and Informatics*, 12(3), 1471–1477. <https://doi.org/10.11591/eei.v12i3.5116>
- Ardani, M. S. H., Sarno, R., Khosasih, M. M., Malikhah, M., Purbawa, D. P., Fatichah, C., Sunaryono, D., Susilo, R. I., Sabilla, S. I., & Sungkono, K. R. (2022). Electronic Nose Signals for Analysing Similarity of Male and Female Axillary Odour to Food Material Aroma. *International Journal of Intelligent Engineering and Systems*, 15(5), 601–611. <https://doi.org/10.22266/ijies2022.1031.52>
- Astuti, S. D., Muhamad, A. B., Rahmatillah, A., Yaqubi, A. K., Susilo, Y., & Aji, A. K. (2023). Electronic Nose (E-Nose) for Quality Detection of Tuna (*Thunnus thynnus*) Contaminated Bacteria. *Indonesian Journal of Tropical and Infectious Disease*, 11(1), 52–65. <https://doi.org/10.20473/ijtid.v11i1.39206>
- Boeker, P. (2014). On “Electronic Nose” methodology. *Sensors and Actuators, B: Chemical*, 204, 2–17. <https://doi.org/10.1016/j.snb.2014.07.087>

- Burlachenko, J., Kruglenko, I., Snopok, B., & Persaud, K. (2016). Sample Handling for Electronic Nose Technology: State of The Art and Future Trends. *TrAC - Trends in Analytical Chemistry*, 82, 222–236. <https://doi.org/10.1016/j.trac.2016.06.007>
- Cha, G., Moon, H. J., Kim, Y., Hong, W., Hwang, J., Park, W., & Kim, Y. (2020). Development of a Prediction Model for Demolition Waste Generation Using a Random Forest Algorithm Based on Small DataSets. *Int. J. Environ. Res. Public Health*, 17(19)(6997), 1–15.
- Chen, Q., Chen, Z., Liu, D., He, Z., & Wu, J. (2020). Constructing an E-Nose Using Metal-Ion-Induced Assembly of Graphene Oxide for Diagnosis of Lung Cancer via Exhaled Breath. *ACS Applied Materials and Interfaces*, 12(15), 17713–17724. <https://doi.org/10.1021/acsami.0c00720>
- Davis, A. P., Gole, T. W., Baena, S., & Moat, J. (2012). The Impact of Climate Change on Indigenous Arabica Coffee (*Coffea arabica*): Predicting Future Trends and Identifying Priorities. *PLoS ONE*, 7(11), 10–14. <https://doi.org/10.1371/journal.pone.0047981>
- Delmo, J. A. B., Villarica, M. V., & Vinluan, A. A. (2022). Correlation Analysis between Sensors for Sensing Coffee Variations. *2022 IEEE 18th International Colloquium on Signal Processing and Applications, CSPA 2022 - Proceeding, May*, 220–224. <https://doi.org/10.1109/CSPA55076.2022.9781998>
- Dwivedi, L. K., & Saket, R. K. (2017). Improve Efficiency of Photovoltaic (PV) System Based by PID Controller. *International Research Journal of Engineering and Technology*, May. [www.irjet.net](http://www.irjet.net)
- Erwanto, D., Rizal, R. F., Yuliana, D. E., Munir, M., Trisnoaji, Y., Harsito, C., Mahadi, A. A., & Prasetyo, S. D. (2024). Development and Application of an Electronic Nose System for Classifying Coffee Varieties Based on Aromatic Profiles. *Journal of Intelligent Systems and Control*, 3(3), 186–200. <https://doi.org/10.56578/jisc030305>
- Estakhroyeh, H. R., Rashedi, E., & Mehran, M. (2018). Design and Construction of Electronic Nose for Multi-purpose Applications by Sensor Array Arrangement Using IBGSA. *Journal of Intelligent and Robotic Systems: Theory and*

- Applications*, 92(2), 205–221. <https://doi.org/10.1007/s10846-017-0759-3>
- Iswanto, B. H., Muflih, A. M., & Baith, H. M. (2024). Low-Cost Electronic Nose for Robusta and Arabica Coffee Classification Using 1-D Convolutional Neural Networks. *Journal of Physics: Conference Series*, 2866(1). <https://doi.org/10.1088/1742-6596/2866/1/012054>
- Jaeschke, C., Gonzalez, O., Glöckler, J. J., Hagemann, L. T., Richardson, K. E., Adrover, F., Padilla, M., Mitrovics, J., & Mizaikoff, B. (2018). *A Novel Modular eNose System Based on Commercial MOX Sensors to Detect Low Concentrations of VOCs for Breath Gas Analysis*. 993. <https://doi.org/10.3390/proceedings2130993>
- Jia, X., Zhou, Q., Wang, J., Liu, C., Huang, F., & Huang, Y. (2019). Identification of Key Aroma-Active Compounds in Sesame Oil from Microwaved Seeds using E-nose and HS-SPME-GC×GC-TOF/MS. *Journal of Food Biochemistry*, 43(10). <https://doi.org/10.1111/jfbc.12786>
- Karakaya, D., Ulucan, O., & Turkan, M. (2020). Electronic Nose and Its Applications: A Survey. *International Journal of Automation and Computing*, 17(2), 179–209. <https://doi.org/10.1007/s11633-019-1212-9>
- Kuria, K. P., Robinson, O. O., & Gabriel, M. M. (2020). Monitoring Temperature and Humidity using Arduino Nano and DHT11 with LCD and datalogger. *International Journal of Engineering Research and Technology (IJERT)*, 9(5). <https://www.ijert.org/research/monitoring-temperature-and-humidity-using-arduino-nano-and-dht11-with-lcd-and-datalogger-IJERTV9IS050149.pdf>
- Lelono, D., Triyana, K., Hartati, S., & Istiyanto, J. E. (2017). Development of Electronic Nose with Highly Stable Sample Heater to Classify Quality Levels of Local Black Tea. *International Journal on Advanced Science, Engineering and Information Technology*, 7(2), 352–358. <https://doi.org/10.18517/ijaseit.7.2.1659>
- Li, Y., Yang, K., He, Z., Liu, Z., Lu, J., Zhao, D., Zheng, J., & Qian, M. C. (2023). Can Electronic Nose Replace Human Nose?—An Investigation of E-Nose Sensor Responses to Volatile Compounds in Alcoholic Beverages. *ACS Omega*, 8(18), 16356–16363. <https://doi.org/10.1021/acsomega.3c01140>

- Loutfi, A., Coradeschi, S., Mani, G. K., Shankar, P., & Rayappan, J. B. B. (2015). Electronic Noses for Food Quality: A Review. *Journal of Food Engineering*, *144*, 103–111. <https://doi.org/10.1016/j.jfoodeng.2014.07.019>
- Lumumba, V. W., Kiprotich, D., Makena, N. G., & Kavita, M. D. (2024). Comparative Analysis of Cross-Validation Techniques: LOOCV, K-folds Cross-Validation, and Repeated K-folds Cross-Validation in Machine Learning Models. *13(5)*, 127–137.
- Motta, I. V. C., Vuillerme, N., Pham, H. H., & de Figueiredo, F. A. P. (2025). Machine Learning Techniques for Coffee Classification: A Comprehensive Review of Scientific Research. *Artificial Intelligence Review*, *58(1)*. <https://doi.org/10.1007/s10462-024-11004-w>
- Muflih, A. M. (2024). *Rancang Bangun E-Nose dengan Variasi Sensor Gas MQ untuk Klasifikasi Kopi*. Skripsi.
- Nasution, I. S., Delima, D. P., Zaidiyah, Z., & Fadhil, R. (2022). A Low Cost Electronic Nose System for Classification of Gayo Arabica Coffee Roasting Levels Using Stepwise Linear Discriminant and K-Nearest Neighbor. *Mathematical Modelling of Engineering Problems*, *9(5)*, 1271–1276. <https://doi.org/10.18280/mmep.090514>
- Novita, D. D., Sesunan, A. B., Telaumbanua, M., Triyono, S., & Saputra, T. W. (2021). Identifikasi Jenis Kopi Menggunakan Sensor E-Nose Dengan Metode Pembelajaran Jaringan Syaraf Tiruan Backpropagation. *Jurnal Ilmiah Rekayasa Pertanian Dan Biosistem*, *9(2)*, 205–217. <https://doi.org/10.29303/jrpb.v9i2.241>
- Oates, M. J., Gonzalez-Teruel, J. D., Ruiz-Abellon, M. C., Guillamon-Frutos, A., Ramos, J. A., & Torres-Sanchez, R. (2022). Using a Low-Cost Components e-Nose for Basic Detection of Different Foodstuffs. *IEEE Sensors Journal*, *22(14)*, 13872–13881. <https://doi.org/10.1109/JSEN.2022.3181513>
- Pancsira, J. (2022). International Coffee Trade: A Literature Review. *Journal of Agricultural Informatics*, *13(1)*, 26–35. <https://doi.org/10.17700/jai.2022.13.1.654>
- Patel, H. K., Austin, R. H., & Barber, J. (2014). The Electronic Nose: Artificial

- Olfaction Technology. In *Biological and Medical Physics, Biomedical Engineering*. <http://link.springer.com/10.1007/978-81-322-1548-6>
- Perez, M., Domínguez-López, I., López-Yerena, A., & Vallverdú Queralt, A. (2023). Current Strategies to Guarantee The Authenticity of Coffee. *Critical Reviews in Food Science and Nutrition*, 63(4), 539–554. <https://doi.org/10.1080/10408398.2021.1951651>
- Poeta, E., Núñez-Carmona, E., & Sberveglieri, V. (2025). A Review: Applications of MOX Sensors from Air Quality Monitoring to Biomedical Diagnosis and Agro-Food Quality Control. *Journal of Sensor and Actuator Networks*, 14(3), 50. <https://doi.org/10.3390/jsan14030050>
- Qisthina, D., Muhammad Fakhri Kurniawan, & Tiana Fitrilia. (2024). Deskripsi Atribut Sensori Tiga Jenis Kopi (Arabika, Robusta, dan Liberika) Asal Indonesia dan Hasil Cupping Score. *Karimah Tauhid*, 3(8), 9031–9042. <https://doi.org/10.30997/karimahtauhid.v3i8.14611>
- Raghavendra, S., & Deka, P. C. (2014). Support Vector Machine Applications In The Field of Hydrology: A Review. *Applied Soft Computing Journal*, 19, 372–386. <https://doi.org/10.1016/j.asoc.2014.02.002>
- Raschka, S., Liu, Y., Mirjalili, V., & Dzhulgakov, D. (2022). *Machine Learning with Pytorch and Scikit-Learn: Develop Machine Learning and Deep Learning Models with Scikit-Learn and PyTorch*.
- Robu.in. (2020). *MQ Series Gas Sensor*. Diakses 12 Juli 2025, dari <https://robu.in/mq-series-gas-sensor/>
- Sarno, R., Izza Sabilla, S., Rahman Wijaya, D., & Hariyanto. (2020). Electronic Nose for Detecting Multilevel Diabetes using Optimized Deep Neural Network. *Engineering Letters*, 28(1), 31–42.
- Sofi'i, I., Arifin, Z., & Harmen. (2022). Prediction of Powdered Coffee Brands Based on Aroma Using Electronic Nose and Artificial Neural Networks. *International Conference on Agriculture and Applied Science (ICoAAS)*, November, 31–36.
- Subandri, M. A., & Sarno, R. (2019). E-Nose Sensor Array Optimization Based on Volatile Compound Concentration Data. *Journal of Physics: Conference*

- Series*, 1201(1). <https://doi.org/10.1088/1742-6596/1201/1/012003>
- Sulistiani, R., Barus, W. A., & Utami, S. (2023). Adaptasi Morfologi dan Fisiologi Bibit Kopi di Dataran Rendah Adaptation of Morphology and Physiology of Coffee Seedlings in Lowlands. *Jurnal Agrium*, 26(2), 168–179.
- Sumanto, B., Java, D. R., Wijaya, W., & Hendry, J. (2022). Seleksi Fitur Terhadap Performa Kinerja Sistem E-Nose untuk Klasifikasi Aroma Kopi Gayo. *MATRIK : Jurnal Manajemen, Teknik Informatika Dan Rekayasa Komputer*, 21(2), 429–438. <https://doi.org/10.30812/matrik.v21i2.1495>
- Sunarharum, W. B., Williams, D. J., & Smyth, H. E. (2014). Complexity of Coffee Flavor: A Compositional and Sensory Perspective. *Food Research International*, 62, 315–325. <https://doi.org/10.1016/j.foodres.2014.02.030>
- Sunil, T. T., Chaudhuri, S., & Mishra, V. (2015). Optimal Selection of SAW Sensors for E-Nose Applications. *Sensors and Actuators, B: Chemical*, 219, 238–244. <https://doi.org/10.1016/j.snb.2015.04.107>
- Telaumbanua, M., Novita, D. D., Triyono, S., & Saragih, C. (2021). Tipe Chamber Dan Posisi Sensor E-Nose Untuk Mendeteksi Aroma Biji Kopi Robusta Menggunakan Mikrokontroler. *Jurnal Ilmiah Rekayasa Pertanian Dan Biosistem*, 9(1), 84–95. <https://doi.org/10.29303/jrpb.v9i1.237>
- Torres, W. L., Araujo, I. B. Q., Filho, J. B. M., & Junior, A. G. C. (2017). Mathematical Modeling and PID Controller Parameter Tuning in a Didactic Thermal Plant. *IEEE Latin America Transactions*, 15(7), 1250–1256. <https://doi.org/10.1109/TLA.2017.7959343>
- Viccione, G., Zarra, T., Giuliani, S., Naddeo, V., & Belgiorno, V. (2012). Performance Study of E-nose Measurement Chamber for Environmental Odour Monitoring. *Chemical Engineering Transactions*, 30(May 2014), 109–114. <https://doi.org/10.3303/CET1230019>
- Vivek Voora, Damon Z., Steffany Bermúdez, C. L., & Baliño, S. (2022). *Global Market Report: Coffee*.
- Wati, D. A. R., & Hidayat, R. (2013). Genetic algorithm-based PID parameters optimization for air heater temperature control. *Proceedings of 2013 International Conference on Robotics, Biomimetics, Intelligent Computational*

*Systems, ROBIONETICS 2013, April, 30–34.*  
<https://doi.org/10.1109/ROBIONETICS.2013.6743573>

Wintgens, J. N. (2012). *Coffee: Growing, Processing, Sustainable Production.*

Yan, J., Guo, X., Duan, S., Jia, P., Wang, L., Peng, C., & Zhang, S. (2015). Electronic Nose Feature Extraction Methods: A Review. *Sensors (Switzerland), 15*(11), 27804–27831. <https://doi.org/10.3390/s151127804>

Ye, Z., Liu, Y., & Li, Q. (2021). Recent progress in smart electronic nose technologies enabled with machine learning methods. *Sensors, 21*(22), 23–26. <https://doi.org/10.3390/s21227620>

Yuan, N., Chi, X., Ye, Q., Liu, H., & Zheng, N. (2023). Analysis of Volatile Organic Compounds in Milk during Heat Treatment Based on E-Nose, E-Tongue and HS-SPME-GC-MS. *Foods, 12*(5). <https://doi.org/10.3390/foods12051071>

Yuwono, S. S., Hanasasmita, N., Sunarharum, W. B., & Harijono. (2019). Effect of Different Aroma Extraction Methods Combined with GC-MS on the Aroma Profiles of Coffee. *IOP Conference Series: Earth and Environmental Science, 230*(1). <https://doi.org/10.1088/1755-1315/230/1/012044>

Zhai, Z., Liu, Y., Li, C., Wang, D., & Wu, H. (2024). Electronic Noses: From Gas-Sensitive Components and Practical Applications to Data Processing. *Sensors, 24*(15). <https://doi.org/10.3390/s24154806>

Zhang, W., Liu, T., Ye, L., Ueland, M., Forbes, S. L., & Su, S. W. (2019). A Novel Data Pre-Processing Method for Odour Detection and Identification System. *Sensors and Actuators, A: Physical, 287*, 113–120. <https://doi.org/10.1016/j.sna.2018.12.028>