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Clinical Performance of Reverse Transcription Loop-mediated Isothermal Amplification COVID-19 Assay on Gold-nanoparticle-modified Screen-printed Carbon Electrode Using Differential Pulse Voltammetry

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Abstract
The World Health Organization (WHO) has recommended real-time reverse transcription polymerase chain reaction (RT-PCR) as the gold standard for coronavirus disease detection. In this study, we aim to validate the clinical performance of reverse transcription loop-mediated isothermal amplification (RT-LAMP) assay on a gold-nanoparticle-modified screen-printed carbon electrode (AuNP/SPCE) using differential pulse voltammetry (DPV) and to compare it with real-time RT-PCR. The electrodeposited AuNP on SPCE was quasi-spherical with a size of ±500 nm. The developed RT-LAMP primer was designed from the GenBank database using the NCBI Multiple Alignment tools and Jalview software. Nasopharyngeal clinical samples were obtained from suspected COVID-19 patients (n = 148). The RT-LAMP products were dropped on the modified AuNP/SPCE under DPV setting, which resulted in current change (ΔI) responses. The positive and negative samples produced significantly different ΔI signals with a p-value <0.0001 at a 95% confidence interval using Student's t-test. The RT-LAMP assay using Au/SPCE exhibited a 30 s response time per analysis. The clinical sensitivity and specificity obtained were 79.7 and 85.1%, respectively, with a detection limit of 0.4 copies μl−1. Hence, this proposed method is suitable for COVID-19 RNA detection in resource-limited settings.

Author Keywords
AuNP/SPCE; COVID-19; differential pulse voltammetry; electrochemical sensor; RT-LAMP; RT-PCR

Index Keywords
Carbon, Electrochemical electrodes, Electrochemical sensors, Gold nanoparticles, Isotherms, Metal nanoparticles, Polymerase chain reaction, Voltammetry; AuNP/SPCE, Clinical performance, Differential pulse voltammetry, Gold nanoparticle, Gold Nanoparticles, Loop mediated isothermal amplifications, Loop-mediated isothermal amplifications, Reverse transcription, Reverse transcription loop-mediated isothermal amplification, Reverse transcription-polymerase chain reaction; COVID-19

References

- (accessed January 2023)
- *Centers for Diseases Control and Prevention (CDC)*, (accessed November 2022)
- Lizhou, X., Danyang, L., Sami, R., Yanbin, L., Norbert, K. (2020) *Biosens. Bioelectron*, 170, p. 2.
- Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Zhang, L. (2020) *Lancet*, 395, p. 508.
- Huang, C., Wang, Y., Xingwang, L., Ren, L., Zhao, J., Hu, Y., Zhang, L., Cao, B. (2020) *Lancet*, 395, p. 500.

- Monteil, S., Casson, A. J., Jones, S. T.
(2021) *PloS One*, 16, p. 1.

- Moço, A. C. R., Guedes, P. H., Flauzino, J. M. R., Silva, S., Vieira, J. G., Castro, A. C., Gomes, E. V. R., Brito-Madurro, A. G.
(2019) *Electroanalysis*, 31, p. 1.

- Lima, L. F. D., Ferreira, A. L., Torres, M. D. T., Araujo, W. R. D., Fuente-Nunez, C. D. L
(2021) *Proc. National Academy of Sciences of the United States of America*, pp. 1-9.

- Tripathy, S., Singh, S. G.
(2020) *Trans. Indian Natl. Acad. Eng*, 5, p. 205.

- Lee, Y., Choi, J., Han, H. K., Park, S., Park, S. Y., Park, C., Baek, C., Min, J.
(2021) *Sens. Actuators, B*, 326, p. 2.

- Zeynaloo, E., Zahran, E., Yang, Y. P., Dikici, E., Head, T., Bachas, L. G., Daunert, S.
(2021) *Biosens. Bioelectron*, 200, p. 2.

- Jain, S., Nehra, M., Kumar, R., Dilbaghi, N., Hu, T. Y., Kumar, S., Kaushik, A., Li, C. Z.
(2021) *Biosens. Bioelectron*, 179, p. 4.

- Alafeef, M., Dighe, K., Moitra, P., Pan, D.
(2020) *Rapid: ACS Nano*, 14, p. 17028.

- Rosati, G., Idili, A., Parolo, C., Fuentes-Chust, C., Calucho, E., Hu, L., Silva, C. D. C. C. E, Merkoci, A.
(2021) *ACS Nano*, 15.

- Malecka, K., Stachyra, A., Góra-sochacka, A., Sirko, A., Zagórski-ostoja, W., Radecka, H., Radecki, J.
(2015) *Sens. Actuators, B*, 224, p. 290.

- Power, A. C., Morri, A.
(2013) *Electrochemistry*,
(IntechOpen, Rijeka) Chap. 7

- Notomi, T., Okayama, H., Masubuchi, H., Yonekawa, T., Watanabe, K., Amino, N., Hase, T.
(2000) *Nucleic Acids Res. Spec. Publ*, 28, p. 63.

- Huang, X., Tang, G., Ismail, N., Wang, X
(2022) *EBioMedicine*, 75, p. 103736.

- Shen, M., Zhou, Y., Ye, J, AL-Maskri, A. A. A., Kang, Y., Zeng, S., Cai, S.
(2020) *J. Pharm. Anal*, 10, p. 97.

- Basu, A., Zinger, T., Inglima, K., Woo, K. M., Atie, O., Yurasits, L., See, B., Aguero-Rosenfeld, M. E.
(2020) *J. Clin. Microbiol*, 58, p. 2.

- Ramírez-Chavarría, R. G., Castillo-Villanueva, E., Alvarez-Serna, B. E., Carrillo-Reyes, J., Torres, L., Ramírez-Zamora, R. M., Buitron, G., Alvarez-Icaza, L.
(2023) *Chemosensors*, 11, p. 2.

- Song, M., Hong, S., Lee, L. P.
(2023) *Adv. Mater*, 35, p. 2.

- Zhang, Y., Odiwuor, N., Xiong, J., Sun, L., Nyaruaba, R. O., Wei, H., Tanner, Na.
(2020) *MedRxiv*, 2, p. 2.

- Patel, K. K, Patel, S. M
(2016) *IJESC*, 6, p. 1.

- *GraphPad Software*,
(accessed Feb 2023)

- Thi, V. L. D., Herbst, K., Boerner, K., Meurer, M., Kremer, L. P. M., Kirrmaier, D., Freistaedter, A., Anders, S.
(2020) *Sci. Transl. Med*, 12, p. 4.

- Aoki, M. N., Coelho, B. D. O., Góes, L. G. B., Minoprio, P., Durigon, E. L., Morello, L. G., Marchini, F. K., Blanes, L.
(2021) *Sci. Rep*, 11, p. 1.

- Yu, L., Wu, S., Hao, X., Dong, X., Mao, L., Pelechano, V., Chen, W. H., Yin, X.
(2020) *Clin. Chem*, 66, p. 975.

- Corman, V. M., Landt, O., Kaiser, M., Molenkamp, R., Meijer, A., Chu, D. K. W., Bleicker, T., Drosten, C.
(2020) *Euro Surveill*, 25, p. 1.

- Benrahma, H., Diawara, I., Smyej, I., Rahoui, J., Meskaouni, N., Benmessaoud, R., Khadija, A., Chakib, N.
(2020) *medRxiv*, 2, p. 10.

- Dong, Y., Zhao, Y., Li, S., Wan, Z., Lu, R., Yang, X., Yu, G., Zhang, C.
(2022) *ACS Sens*, 7, p. 730.

- Jang, W. S., Lim, D. H., Yoon, J., Kim, A., Lim, M., Nam, J., Yanagihara, R., Lim, C. S.
(2021) *PloS One*, 16, p. 1.

- Zakaria, N. D., Omar, M. H., Ahmad Kamal, N. N., Abdul Razak, K., Sönmez, T., Balakrishnan, V., Hamzah, H. H.
(2021) *ACS Omega*, 6, p. 24419.

- Drobysh, M., Liustrovaite, V., Baradoke, A., Viter, R., Chen, C. F., Ramanavicius, A., Ramanaviciene, A.
(2022) *Biosens*, 12, p. 3.

- Kim, H. Y., Lee, J. H., Kim, M. J., Park, S. C., Choi, M., Lee, W., Ku, K. B, Kim, S. I.
(2021) *Biosens*, 175, p. 1.

- Johnston, M., Ates, H. C., Glatz, R. T., Mohsenin, H., Schmachtenberg, R., Göppert, N., Huzly, D., Dincer, C.
(2022) *Mater. Today*, 61, p. 129.

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