Scopus

Documents

Zayan, J.M.[a] , John, A.[b] , Rasheed, A.K.[c] , Alallam, B.[d] , Khalid, M.[e] , Ismail, A.F.[a] , Nelson, B.R.[f] , Mohd Salleh, H.[g]

EARLIER DENATURATION OF DNA BY USING NOVEL TERNARY HYBRID NANOPARTICLES

(2022) *IIUM Engineering Journal*, 23 (2), pp. 237-245.

DOI: 10.31436/iiumej.v23i2.2148

[a] Department of Mechanical Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

[b] Institute of Oceanography and Maritime Studies (INOCEM), Kulliyyah of Science, International Islamic University Malaysia, Kuantan, Malaysia

[c] Department of New Energy Science and Engineering, School of Energy and Chemical Engineering, Xiamen University Malaysia. Jalan Sunsuria, Bandar Sunsuria, Sepang, 43900, Malaysia

[d] Integrated Medical Center, Advanced Medical and Dental Institute13200, Malaysia

[e] Graphene and Advanced 2D Materials Research Group, Level 4, East Wing -NUB, School of Science and Technology, Sunway University, Sunway City, Petaling Jaya, 47500, Malaysia

[f] Institute of Topical Biodiversity and Sustainable Development, Universiti Malaysia Terengganu, Terengganu, Kuala Nerus, 21030, Malaysia

[g] International Institute for Halal Research and Training (INHART), International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract

Two novel ternary hybrid nanoparticles (THNp) consisting of graphene oxide (GO) and reduced graphene oxides (rGO) were added to samples of DNA. The effect of the addition of nanoparticles on the thermal denaturation of DNA samples was studied by measuring the absorbance using a temperature-controlled Perkin Elmer UV spectrophotometer. Adding GO-TiO2-Ag and rGO-TiO2-Ag nanoparticles lowered the denaturation temperature of template DNA significantly. The nanoparticles affect the denaturation rate. The optimal GO-TiO2-Ag and rGO-TiO2-Ag concentrations were found to be 5 × 10-2, which resulted in 86-and 180-folds augmentation of DNA denaturation (6.5 µg/mL), respectively, while it resulted in 2- and 7-folds augmentation of DNA denaturation (11.5 µg/mL), respectively, at temperature as low as 80 °C. The results indicated that rGO-TiO2-Ag nanoparticles exhibited significantly higher DNA denaturation enhancement than rGO-TiO2-Ag nanoparticles, owing to their enhanced thermal conductivity effect. Therefore, these nanoparticles could help to get improved PCR yield, hence enable amplification to be performed for longer cycles by lowering the denaturation temperatures. © 2022

Author Keywords

Dna denaturation; hybrid nanoparticles; nano-PCR; polymerase chain reaction (PCR)

References

- Fu, -Ming SANG, Xin, LI, Jia, LIU.
  Development of nano-polymerase chain reaction and its application
  (2017) *Chinese Journal of Analytical Chemistry*, 45 (11), pp. 1745-1753.
  [1]

- Lorenz, TC.
  Polymerase chain reaction: Basic protocol plus troubleshooting and optimization strategies
  (2012) *JoVE (Journal of Visualized Experiments)*, 63, p. e3998.
  [2]

- Ussery, DW.
  (2013) *DNA Denaturation, Brenner's Encycl. Genet. Second Ed*, pp. 353-355.
  [3]

- Shen, C, Yang, W, Ji, Q, Maki, H, Dong, A, Zhang, Z.
  NanoPCR observation: Different levels of DNA replication fidelity in nanoparticle-enhanced polymerase chain reactions
  (2009) *Nanotechnology*, 20 (45), p. 455103.
  [4]

- Cazzaniga, G, Songia, S, Biondi, A.
  PCR Technology to Identify Minimal Residual Disease
  (2021) *Leukemia Stem Cells*, pp. 77-94.
  [5] Humana, New York, NY

- Gabriel, S, Rasheed, AK, Siddiqui, R, Appaturi, JN, Fen, LB, Khan, NA.
  Development of nanoparticle-assisted PCR assay in the rapid detection of brain-eating amoebae

(2018) *Parasitology research*, 117 (6), pp. 1801-1811.
[6]

- Lin, YC, Wu, HL.
Nano-PCR: Breaking the bottom limit of the PCR denaturation temperature using nanogold
(2007) *TRANSDUCERS 2007. IEEE International Solid-State Sensors, Actuators and Microsystems Conference*, pp. 391-394.
[7]

- Khaliq, A, Sonawane, PJ, Sasi, BK, Sahu, BS, Pradeep, T, Das, SK, Mahapatra, NR.
Enhancement in the efficiency of polymerase chain reaction by TiO2 nanoparticles: crucial role of enhanced thermal conductivity
(2010) *Nanotechnology*, 21 (25), p. 255704.
[8]

- Khaliq, A, Kafafy, R, Salleh, HM, Faris, WF.
Enhancing the efficiency of polymerase chain reaction using graphene nanoflakes
(2012) *Nanotechnology*, 23 (45), p. 455106.
[9]

- Rasheed, AK, Siddiqui, R, Ahmed, SMK, Gabriel, S, Jalal, MZ, John, A, Khan, NA.
hBN nanoparticle-assisted rapid thermal cycling for the detection of Acanthamoeba
(2020) *Pathogens*, 9 (10), p. 824.
[10]

- Zayan, M, Rasheed, AK, John, A, Muniandi, S, Faris, A.
Synthesis and Characterization of Novel Ternary Hybrid Nanoparticles as Thermal Additives in H2O
(2021) *ChemRxiv*,
[11]

- Abbotts, R, Wilson, DM.
3rd. Coordination of DNA single strand break repair
(2017) *Free Radic Biol Med*, 107, pp. 228-244.
[12]

- Li, A, Zhou, B, Alves, CS, Xu, B, Guo, R, Shi, X, Cao, X.
Mechanistic studies of enhanced PCR using PEGylated PEI-entrapped gold nanoparticles
(2016) *ACS Applied Materials & Interfaces*, 8 (39), pp. 25808-25817.
[13]

- Lee, JY, Lim, HW, Yoo, SI, Zhang, BT, Park, TH.
Simulation and real-time monitoring of polymerase chain reaction for its higher efficiency
(2006) *Biochemical Engineering Journal*, 29 (1-2), pp. 109-118.
[14]

- Bai, Y, Cui, Y, Paoli, GC, Shi, C, Wang, D, Shi, X.
Nanoparticles affect PCR primarily via surface interactions with PCR components: using amino-modified silica-coated magnetic nanoparticles as a main model
(2015) *ACS Applied Materials & Interfaces*, 7 (24), pp. 13142-13153.
[15]

Correspondence Address
John A.; Institute of Oceanography and Maritime Studies (INOCEM), Malaysia; email: akbarhohn50@gmail.com

Publisher: International Islamic University Malaysia-IIUM

ISSN: 1511788X
Language of Original Document: English
Abbreviated Source Title: IIUM Eng. J.

2-s2.0-85134658096
Document Type: Article
Publication Stage: Final
Source: Scopus