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Details of the Collaborative Activity

2019-20

Name of the Collaborating Institute: University of Texas at El Paso, TX-USA

Name of the Collaborating Department from YDU: Yenepoya Research Center

Activities:

Joint Research and Publication:

Dr. K S Sudhakaraprasad from Yenepoya Research Center collaborated with the University of Texas and published a joint paper.

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ATTESTED

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A new method to amplify colorimetric signals of paper-based nanobiosensors for simple and sensitive pancreatic cancer biomarker detection†

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A low-cost, sensitive, and disposable paper-based immunosensor for instrument-free colorimetric detection of pancreatic cancer biomarker PEAK1 was reported for the first time by capitalizing the catalytic properties of gold nanoparticles in colour dye degradation. This simple signal amplification method enhances the detection sensitivity by about 10 fold.

Early detection of a disease biomarker is crucial to the timely treatment of diseases.[1] There is an urgent need for rapid monitoring of disease biomarkers for cancer, a non-communicable disease that contributes a large number for the increasing global mortality.[2,3] According to the World Health Organization, there are 8.8 million people who died worldwide due to cancer,[4] and the current data from the American Cancer Society forecast 1 688 780 new cases of cancer and 600 920 deaths in the US.[5] 57% percent of new cancer cases arise in developing nations and the figure could reach 70% by 2050.[6,7] Their cancer mortality now accounts for 70% of cancer deaths worldwide.[7–11] Among these cancer cases, pancreatic cancer caused an estimated number of 43 090 deaths in the US in 2017. Pancreatic cancer mostly occurs in the exocrine pancreas, namely pancreatic ductal adenocarcinoma (PDAC). PDAC is the fourth-leading cause of cancer death in the US, and the incidence of PDAC is increasing compared to other types of cancer.[5,12–14] Since the pancreas is deep inside the body, regular screening may not identify the early progression of such a tumour. Additionally, the lack of symptoms at early stages makes the tumour difficult to be identified. The appearance of symptoms after PDAC spreads to other organs further decreases the 5-year survival rate to approximately 5%.[15] Therefore, a low-cost method for rapid and reliable early diagnosis of PDAC is in great need.

Recently, Kelber *et al.* discovered that a novel tyrosine kinase, PEAK1 (pseudopodium-enriched atypical kinase one, SGK269), could be used as a biomarker for PDAC.[13] Developing an immunosensor for PEAK1 that fulfills the conditions of a point-of-care tool with simple, sensitive, portable, rapid, low-cost and miniature features will be of great importance for the early clinical diagnosis of PDAC. However, traditional immunoassay methods with various sensing strategies such as radiation,[16] fluorescence,[17,18] surface plasmon resonance (SPR),[19,20] quartz crystal microbalance,[21] well-known enzyme-linked immunosorbent assays (ELISA),[22,23] chemiluminescence[24] and electrochemistry[25–28] require complex, expensive instruments and skilled operators. Furthermore, conventional methods including tissue immunohistochemistry and western blotting for PEAK 1 measurement are invasive, cumbersome, and costly, and they can only provide semi-quantitative results.[29,30] Although electrochemical detection can provide quantitative data, it requires an expensive potentiostat, creating a challenge for point-of-care detection.[28] Considering these hindrances, a much simpler paper-based colorimetric assay method shows potential for low-cost point-of-care detection of the PDAC biomarker PEAK1, because of its simplicity, low cost, requirement of a low volume of sample, and disposable nature.[23,31–40]

Gold nanoparticles (AuNPs) with 10–50 nm diameter are commonly used in various colorimetric assays and exhibit red colour in a dispersed state and present a purple or blue colour in an aggregated state due to their interparticle distance and size-dependent localized surface plasmon resonance.[38,41] However, due to low sensitivity resulting from poor signal amplification, signal enhancement techniques such as enzyme

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