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"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

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JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST046) DEVELOPMENT OF A PAPER-BASED BIOSENSOR FOR RAPID DETECTION OF BREAST CANCER

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ABSTRACT

Breast cancer is one of the most life-threatening diseases among millions of people worldwide. Early detection and diagnosis can increase the chance of successful treatment. This study aimed to develop an affordable paper-based biosensor for rapid detection of breast cancer biomarkers antigens (carcinoembryonic antigen (CEA) and CA-153) in peripheral blood. Paper-based biosensor techniques have been known to offer the advantages of producing simple, low-cost, and portable testing devices. The result was easily analysed by detecting the colour change due to antibody-antigen binding. The paper strip will be coated with specific antibodies against CEA and CA-153 and serve as a substrate. The blood sample from the finger prick will be loaded onto the sample pad and allowed to be absorbed, initiating migration to the strip. The sample flows through the conjugation pad containing gold particle-conjugated antibodies. A positive result indicates the presence of CEA and CA-153 antigens, which can be observed by double-coloured lines in the detection pad. A control line indicates the functionality of the kit. The absence of a double-coloured line indicates a negative result. By providing a quick and efficient way to test for breast cancer, the rapid test kit has the potential to save lives and improve the overall quality of healthcare for millions of individuals worldwide.

Keywords: Breast cancer, biosensor, carcinoembryonic antigen, CA-153

1.0 INTRODUCTION

Breast cancer is the leading cause of cancer-related death worldwide and in Malaysia. Approximately 2.2 million new cancer cases and more than 10 million deaths occurred in 2020. It is approximately more than 680,000 deaths among women globally, as reported by the World Health Organization/International Agency for Cancer Research in the '2020 Global Cancer Report' (Sung et al., 2021). In Malaysia, breast cancer accounts for 19% of all cancer cases, with one out of five cancer patients diagnosed with breast cancer. Malaysian women's age-standardized incidence rates of breast cancer have been rising, reaching 34.1 in 2016 (Azizah et al., 2016). Over the past few years, there has been a gradual rise in the occurrence of breast cancer, particularly among adolescents (Fernandes et al., 2023). Recently, an estimated 47.9% of women in Malaysia were diagnosed with cancer at Stage III and IV, despite the implementation

of early screening, prevention, and control programmes (Azizah et al., 2019; Dahlui et al., 2011; Islam et al., 2018). For over three decades, carcinoembryonic antigen (CEA) and cancer antigen 15–3 (CA15-3) have been recommended as serum tumour markers in the clinical management of breast cancer (Shao et al., 2015). CA15-3 is a large glycoprotein (300-450 kDa) produced by the apical surface of epithelial ducts and acinic breast cells and is subsequently released into milk. CA15-3 is found in the bloodstream in cases of cancerous breast morphology disruption (Fejzić et al., 2015). Meanwhile, the CEA is a glycoprotein in the human digestive system, which plays a crucial role in cell adhesion. It is frequently elevated in the blood, indicating tumour metastasis (Bidard et al., 2012; Yerushalmi et al., 2012). Clinical practice has focused on early breast cancer detection and treatment to minimise patient mortality and enhance the quality of life. Currently, breast cancer is screened and diagnosed using various methods such as imaging, ultrasound, pathology, and serum tumour marker detection (Luo et al., 2023). Despite the accessibility of advanced therapeutic approaches and detection technologies, mortality and morbidity due to breast cancer remain significant issues worldwide. Moreover, conventional screening approaches require expensive costs, are time-consuming, and are inconvenient for follow-up screening. Therefore, a better prognosis for the survival of cancer patients depends on early detection. Developing a significant, cost-effective, and user-friendly paper-based biosensor antigen home test kits can revolutionise cancer treatment.

2.0 OBJECTIVE

This study aims to develop an affordable paper-based biosensor for rapid detection of breast cancer biomarkers antigens (carcinoembryonic antigen (CEA) and CA-153) using peripheral blood.

3.0 METHODOLOGY

A paper-based biosensor will be developed based on the principle of lateral flow assays (LFA). The LFA will be composed of four main components: a sample pad, conjugate release pad, test pad, and absorbent pad. These components will be securely attached to a supporting card for secured and appropriate handling (Figure 1). The sample pad enables the appropriate interactions of peripheral blood samples that contain CEA/CA153 antigens on the conjugate pad and the nitrocellulose membrane. It also manages and distributes sample flow homogeneously. The conjugate pad contains antibodies that are specific to the antigen. The conjugate pad then allows the release of molecules (fluorescence) that are conjugated to the antibodies towards the test pad. The membrane between the conjugate pad and the test pad is important for the interaction of conjugate molecules with the target antigens. It will also provide the surface for the interaction of conjugate molecules at the border of the test line and control line. The test line shows the colour change that indicates the concentration of the target analytes for qualitative analysis. On the other hand, the control line represents the positive capillary flow of the sample. The absorbent pad is designed to maintain the capillary action rate and prevent the sample's backflow (Koczula & Gallotta, 2016).

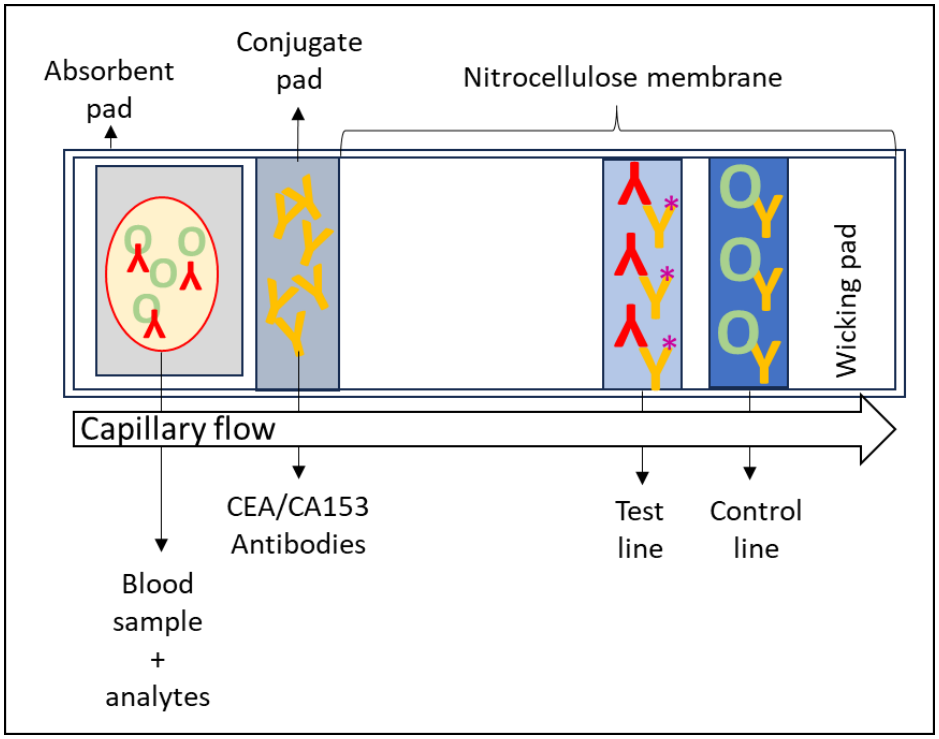

Figure 1: Description of a paper-based biosensor

4.0 RESULTS

Early detection of breast cancer is important for enhancing patient survival rates. This study introduces a novel paper-based biosensor for rapid detection of breast cancer biomarkers (CEA and CA15-3). This biosensor utilises the idea of the LFA approach to provide a cost-effective, user-friendly, and rapid diagnostic solution. In contrast to conventional diagnostic procedures, this biosensor only requires a small amount of sample (peripheral blood) and rapid processing duration with immediate findings, which is convenient for the user. This biosensor's price and simplicity could significantly decrease the expenses associated with breast cancer screening and diagnosis, making it a financially feasible alternative for patients and healthcare systems.

5.0 CONCLUSION

Early detection of breast cancer is crucial for better prognosis. Developing a simple and inexpensive detection approach can decrease the rate of morbidity and mortality of cancer patients. Thus, this research introduces a novel paper-based biosensor for rapid detection of breast cancer biomarkers. The innovation of this biosensor will have a significant impact on human health and the economy of healthcare systems.

REFERENCES

Azizah, A., Hashimah, B., Nirmal, K., Siti Zubaidah, A., Puteri, N., Nabihah, A., Sukumaran, R., Balqis, B., Nadia, S., & Sharifah, S. (2019). Malaysia National Cancer

Registry Report (MNCR). National Cancer Institute, Ministry of Health: Putrajaya, Malaysia.

Azizah, Ab. M., Nor Saleha, I, T., Noor Hashimah, A., Asmah, Z. A., & Mastulu, W. (2016). Malaysian National Cancer Registry Report: 2007-2011 Malaysia Cancer Statistics, Data and Figure.

Bidard, F.-C., Hajage, D., Bachelot, T., Delaloge, S., Brain, E., Campone, M., Cottu, P., Beuzeboc, P., Rolland, E., & Mathiot, C. (2012). Assessment of circulating tumor cells and serum markers for progression-free survival prediction in metastatic breast cancer: a prospective observational study. Breast Cancer Research, 14, 1–10.

Dahlui, M., Ramli, S., & Bulgiba, A. M. (2011). Breast cancer prevention and control programs in Malaysia. Asian Pacific Journal of Cancer Prevention, 12(6), 1631–1634.

Fernandes, U., Guidi, G., Martins, D., Vieira, B., Leal, C., Marques, C., Freitas, F., Dupont, M., Ribeiro, J., & Gomes, C. (2023). Breast cancer in young women: a rising threat: A 5-year follow-up comparative study. Porto Biomedical Journal, 8(3), e213.

Islam, T., Su, T. T., Musthaffa, S., Din, N. A., Rahman, Z., Mohamed, K. N., Kaur, S., Beaumont, C. E., Crawford-Gray, K., & Filza, J. (2018). Improving Breast Health Literacy Through an Innovative Breast Cancer Awareness Campaign Using the Know Your Lemons (KYL) Materials in Malaysia—American Society of Clinical Oncology.

Koczula, K. M., & Gallotta, A. (2016). Lateral flow assays. Essays in Biochemistry, 60(1), 111–120.

Luo, J., Xiao, J., Yang, Y., Chen, G., Hu, D., & Zeng, J. (2023). Strategies for five tumour markers in the screening and diagnosis of female breast cancer. Frontiers in Oncology, 12, 1055855.

Shao, Y., Sun, X., He, Y., Liu, C., & Liu, H. (2015). Elevated levels of serum tumor markers CEA and CA15-3 are prognostic parameters for different molecular subtypes of breast cancer. PloS One, 10(7), e0133830.

Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., & Bray, F. (2021). Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA: A Cancer Journal for Clinicians, 71(3), 209–249.

Yerushalmi, R., Tyldesley, S., Kennecke, H., Speers, C., Woods, R., Knight, B., & Gelmon, K. A. (2012). Tumor markers in metastatic breast cancer subtypes: frequency of elevation and correlation with outcome. Annals of Oncology, 23(2), 338–345.