TEST-STRIPS FOR MONITORING CANCER BIOMARKERS IN POINT-OF-CARE

Mariana C.C.G. Carneiro[1,2], Lígia R. Rodrigues[2], Felismina Moreira[1,2], M. Goreti F. Sales[2,3]

[1)]BioMark@ISEP, School of Engineering, Polytechnic Institute, Porto, Portugal;

[2)]CEB, Centre of Biological Engineering, Minho University, Braga, Portugal;

[3)]BioMark@UC, Faculty of Sciences and Technology, Coimbra University, Coimbra, Portugal

Introduction

There is an urgent need for new biomarkers and methodologies for cancer diagnosis…

Main goal

Biorecognition elements + **Transduction system** → **Sensing approaches to monitor cancer biomarkers in point-of-care**

Selective, stable, low-cost — **Optical** — **Smaller, faster, cheaper**

Specific objectives

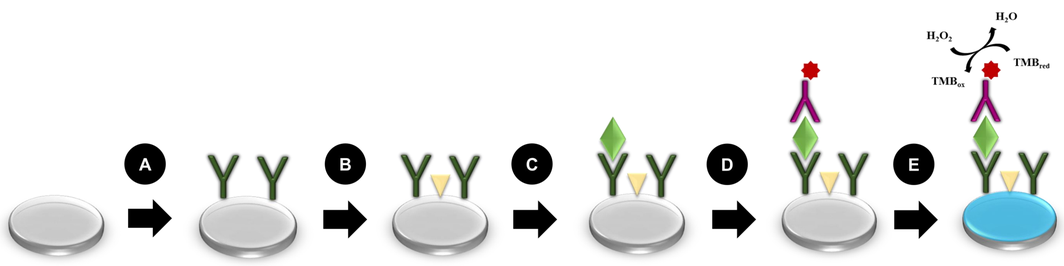
1. Selection of suitable polymer-based supports;
2. Production of synthetic biorecognition elements (molecularly imprinted polymers and aptamers);
3. Signal transduction to generate analytical data.

Minimum economic/ environmental impact

The main objective is to develop a simple and cost-effective test strip for rapid detection of cancer biomarkers at the point-of-care by combining renewable substrates (cellulose paper), artificial biorecognition elements (molecularly imprinted polymers and aptamers) and optical (colorimetric) detection. These materials have advantages in terms of cost and stability compared to natural antibodies and the system benefits from the simplicity of optical detection.

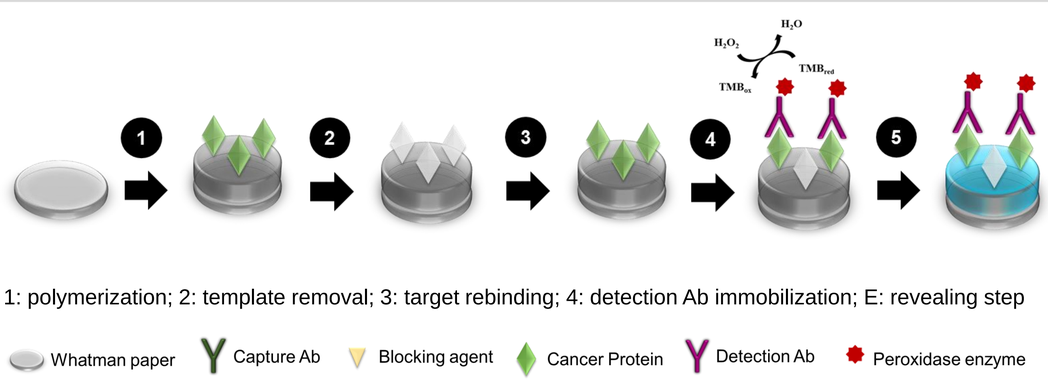
Methodology

Scheme 1 – Paper-based ELISA for cancer protein detection



A: capture Ab immobilization; B: blocking step; C: target binding; D: detection Ab immobilization; E: revealing step

Scheme 2 - Paper-based biomimetic ELISA for cancer protein detection



1: polymerization; 2: template removal; 3: target rebinding; 4: detection Ab immobilization; E: revealing step

Results

Colour development is ensured by incubating the sensor in an unveiling solution that produces a blue colour on the paper substrate proportional to the target concentration. Subsequently, the results allow semi-quantification (by naked eye) or quantification of cancer proteins (by taking an image with a smartphone camera and analysing the colour coordinates, as RBG/HSL, with software, as ImageJ).

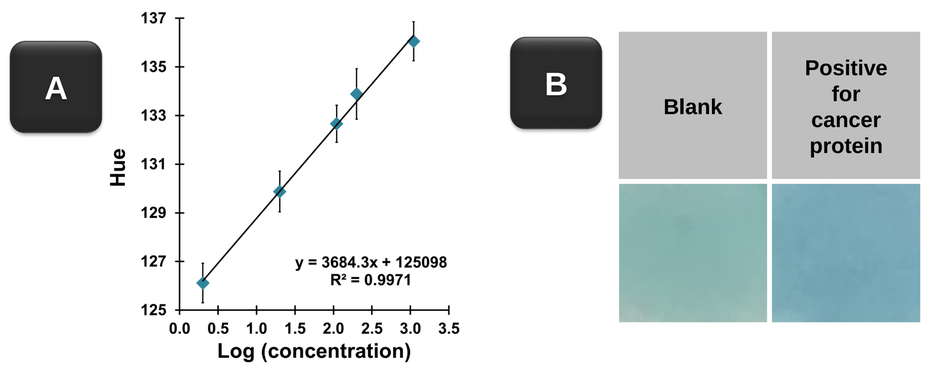


Figure 1 – (A) Calibration curve based on hue values extracted from the photographic results

(B) Photographs of the colorimetric sensor showing the color change in the presence of the target

General considerations

Current methodologies for cancer diagnosis are complex and provide a late diagnosis. New methodologies are urgently needed for an earlier and accurate diagnosis enabling an effective therapeutic and thus improving the survival rates. Biosensors, like the one presented herein, are an interesting tool for cancer biomarkers detection in point-of-care devices enabling the detection of molecules outside of laboratory, as home or at doctor's office.

Herein, a colorimetric immunosensor was firstly developed in a cellulose substrate to optimize the colorimetric detection system. Currently, another colorimetric sensor is under development, based on a molecularly imprinted polymer as biorecognition element, thus reducing the cost of the assay and improving its stability and performance. In the future, an aptamer will be used to recognize another cancer protein. This work evidences the benefits of synthetic antibodies to target different proteins, including cancer biomarkers.

Acknowledgments

Authors acknowledge funding to Fundação para a Ciência e Tecnologia, I.P., through the PhD grant reference SFRH/BD/131959/2017.