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Design of a disposable µPAD for on-hand quantification of urinary creatinine

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In this work, a new microfluidic paper-based analytical device (µPAD) was developed for on-hand creatinine quantification in urine samples. This is clinically significant since creatinine monitorization in urine is an indicator of health condition, as kidney-failure [1]. When compared with conventional methods, this innovative µPAD approach is more accessible, portable, providing low-cost analysis and applicable to non-invasive biological fluids [2]. Additionally, the µPAD is environmentally friendly, as it uses small amounts of reagents, results in low waste production, and is disposal by incineration.

The developed µPAD configuration consisted in two layers of filter paper discs (9.5 mm of diameter) staked into a hydrophilic unit and aligned into a laminated plastic pouch (hydrophobic zone), with 3 mm holes for the standard/sample insertion. The top layer served as a reservoir and the bottom layer contained the reagent (alkaline picrate). After the standard/sample loading, creatinine reacts with picric acid in alkaline conditions, forming an orange/red complex. The colour was registered by scanning the µPAD and the image processed in ImageJ software to obtain the colour intensity values then used to calculate the absorbance. A linear correlation was established between the creatinine concentration and the calculated absorbance values. The µPAD operational parameters were studied to attain the best sensitivity (calibration curve slope) for creatinine determination within the dynamic range of 2.20 - 35.0 mg/dL with a limit of detection (LOD) of 0.66 mg/dL and a limit of quantification (LOQ) of 2.2 mg/dL.

Finally, the method was validated by analysing several urine samples with the developed µPAD and comparing the results with a comparative batchwise process, and it was demonstrated that there were no statistically significant differences between them.

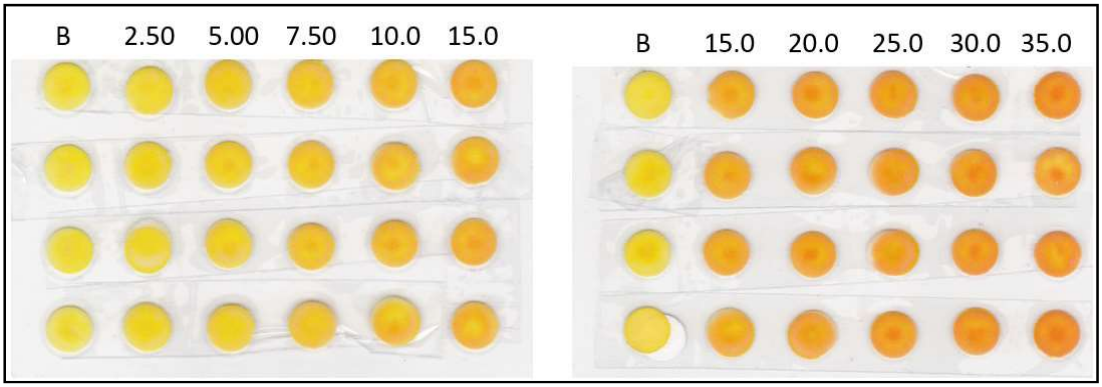

Fig. 3. Scanned images of µPADs after insertion of creatinine standard solutions (in mg/dL); B – blank solution.

Acknowledge

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References

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