3D MODELS FOR BIOSENSING EXPLOITING BIOLUMINESCENCE DETECTION

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Abstract

Cell-based assays are widely exploited for drug screening and biosensing, providing useful information about bioactivity of target analytes and complex biological samples. It is well recognized that 3D cell models are required to achieve highly valuable information, also from the perspective of replacing animal models. However, they are generally highly demanding in terms of facilities, equipment, and skilled personnel requirements. Several organ-on-chip and cell-on-chip devices have been reported, but their main drawback is that they are not interoperable (i.e., they have been fabricated with customized equipment, thus cannot be applied in other facilities, unless having the same setup). As a consequence, results obtained with such devices do not generally comply with the FAIR's principles (findability, accessibility, interoperability, and reusability). To overcome such limitation leveraging cost-effective 3D-printing, a bioluminescent tissue on-a-chip device, easily implemented in any laboratory, has been developed [1]. The device enables continuous monitoring of cell co-cultures expressing different bioluminescent reporter proteins and, thanks to the implementation of new highly bioluminescent luciferase enzymes having high pH and thermal stability, can be monitored via smartphone camera [2,3]. Another relevant feature is the possibility to insert the chip into a commercial 24-well plate for use with standard benchtop instrumentation. The suitability of this device for 3D cell-based biosensing for monitoring activation of target molecular pathways, i.e., the inflammatory pathway via nuclear factor kappa-B (NF-κB) activation, and general cytotoxicity was evaluated showing similar analytical performance when compared to conventional 3D cell-based assays performed in 24-well plates. In addition, hypoxia signaling and the p53 pathway were also investigated, showing good potential for applications of this sustainable and low-cost 3D-printed microfluidic platform for bioactivity analyses, drug screening, and precision medicine [4].

References

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