"PHOTOACT": A NOVEL, LOW-COST, IN-HOUSE BUILT LED-BASED DEVICE TO SUCCESSFULLY PERFORM *IN VITRO* PHOTODYNAMIC THERAPY ASSAYS

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INTRODUCTION

Photodynamic therapy (PDT) is a clinically approved therapeutic approach for solid tumors, combining the administration of a photosensitizer (PS) followed by light irradiation to generate reactive oxygen species (ROS) to exerts selective cytotoxicity in tumor cells. Commercial LED-based PDT equipment presents drawbacks such as lack of portability, high cost and complex construction/operation. Considering this challenge, our study presents PhotoACT, an economical and simple solution which can be used as a research tool on PDT experiments.

MATERIAL AND METHODS

Internal Structure: medium-density fiberboards (MDF), black ink to avoid light reflection, 30 LEDs RGB WS2812, TSL2561 brightness sensor. External structure: MDF bigger box sealed to avoid both exterior light interference and emitted light loss. Electronics: online designed (SketchUp) 3D printed (Finder, Flashforge) control unit with all electronic components installed at ports of an ESP32 controller board. Operational system: programming in C language through Arduino and code structure based on FreeRTOS.

RESULTS

The final project included a dark chamber to allocate up to four multi-well microplates and with its upper interior surface equipped with a set of scattered LEDs programmed to emit distinct spectrums of visible light. As a proof of concept, the device was used to enhance the cytotoxic effect of verteporfin in 2D HeLa cell culture after light exposure for 1 hour (average fluence of 50J/cm^2). The IG_{50} value was 3.1μM and 13.8μM for light and dark condition, respectively. Under the same fluence condition, this shift of 4.4-fold was also verified in experiments using a commercial option of PDT device (LumaCare®), validating the applicability of PhotoACT on PDT assays.

CONCLUSIONS

PhotoACT was easily built with commercially available components costing less than $50 and its use is recommended for universities, industries, and other research centers. Additional advantages include low maintenance demand, portability, accurate and reproducible irradiation, and user-friendly setup interface. PhotoACT should extend the benefits of PDT to scientific research exploring its mechanism of action and clinical applications.

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