IOCFB 2026 Conference
The 2nd International Online Conference on Functional Biomaterials
8–10 July 2026 | Online
MDPI

Photodynamic Therapy: A Promising Strategy for Alveolar Bone Regeneration

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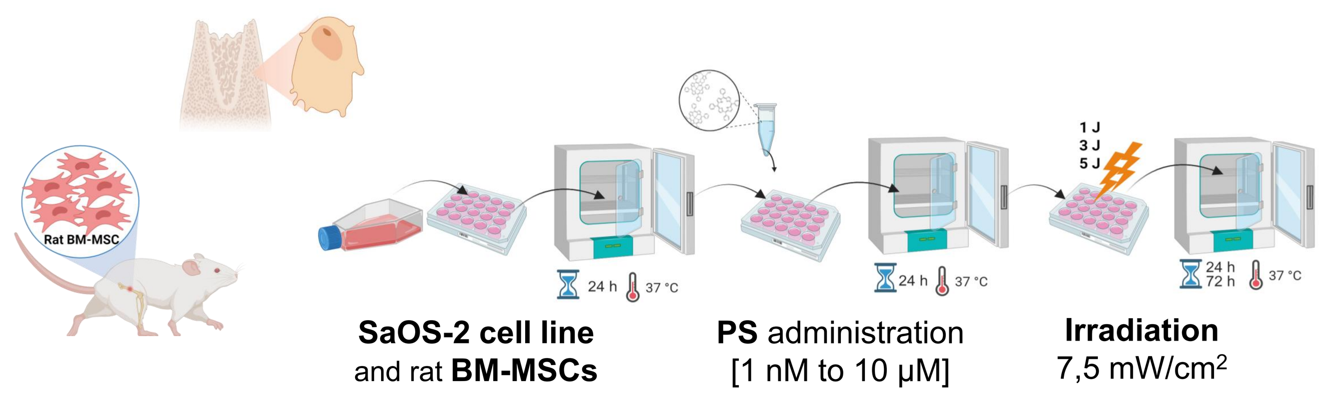
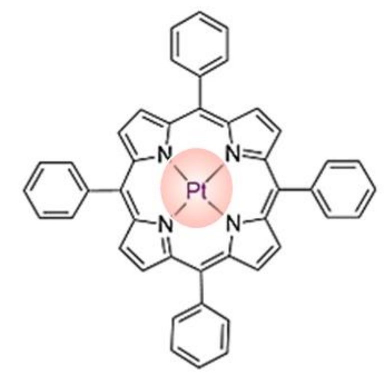
INTRODUCTION & AIM

Alveolar bone loss can result from multiple dental conditions or systemic pathologies, with functional and aesthetic consequences. The treatment of such defects remains a major clinical challenge, largely due to the limited regenerative capacity of alveolar bone. **Photodynamic therapy (PDT)** represents a promising approach to **bone regeneration** by modulating cellular activity through photochemical processes.

Thus, the main objective of this study was to investigate the effects of **Porphyrin 1a (meso-tetraphenylporphyrin with Pt (II))** on bone cells' function and on the **osteogenic differentiation** of rat bone marrow stem cells (**BM-MSCs**). Additionally, it was intended to optimise the therapeutic protocol regarding the **photosensitiser** concentration and **light exposure regimens.**

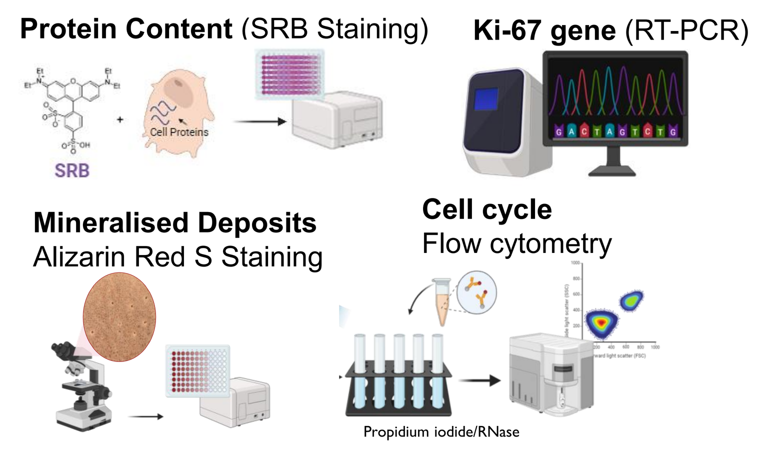
METHODS



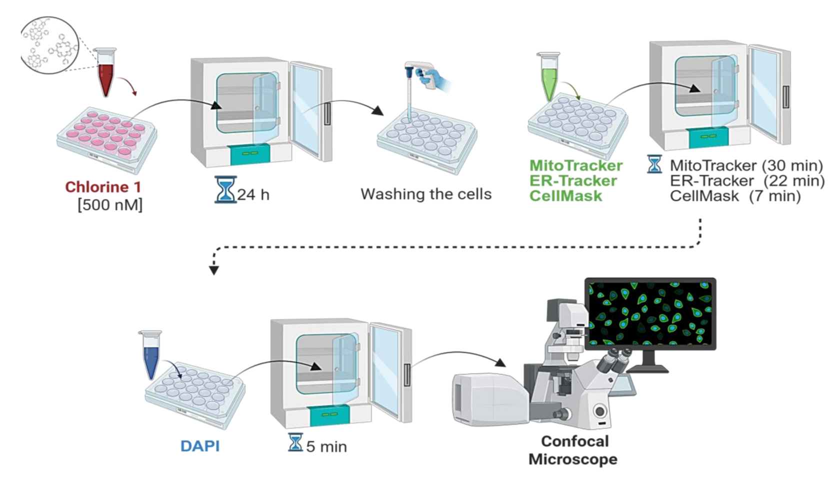


Porphyrin 1a

Proliferation and cell function assays

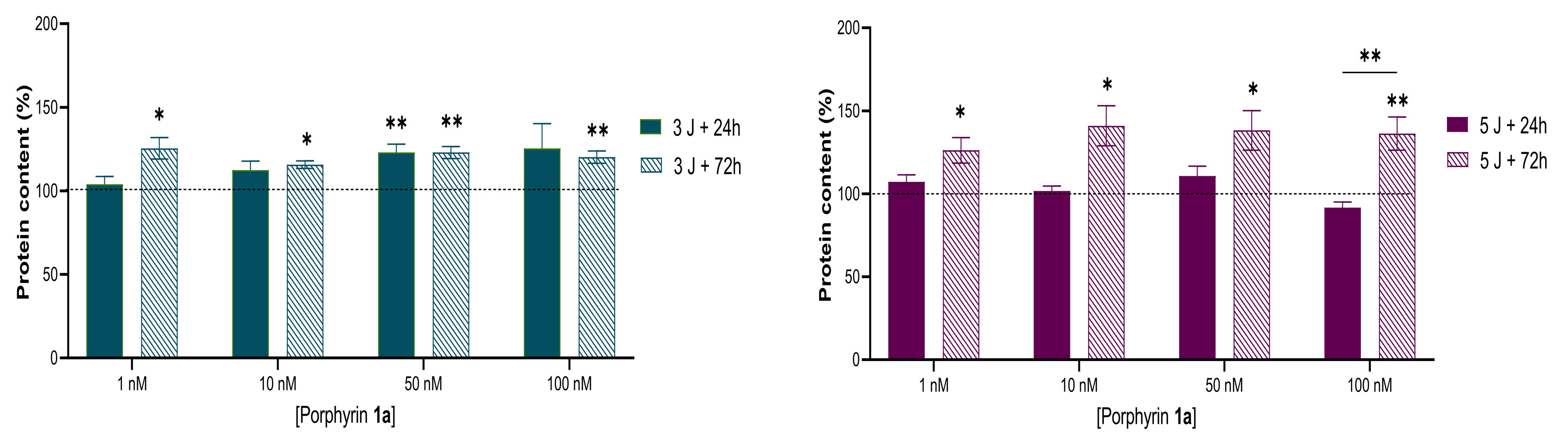


Subcellular Localisation (Confocal Microscopy)

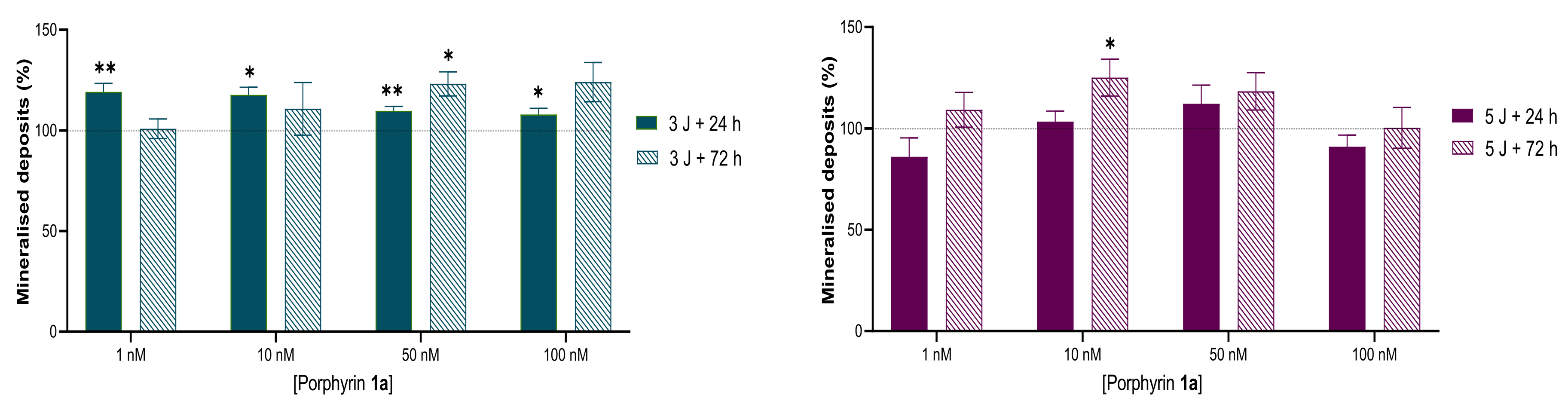


RESULTS & DISCUSSION

SaOS-2 Cell Line



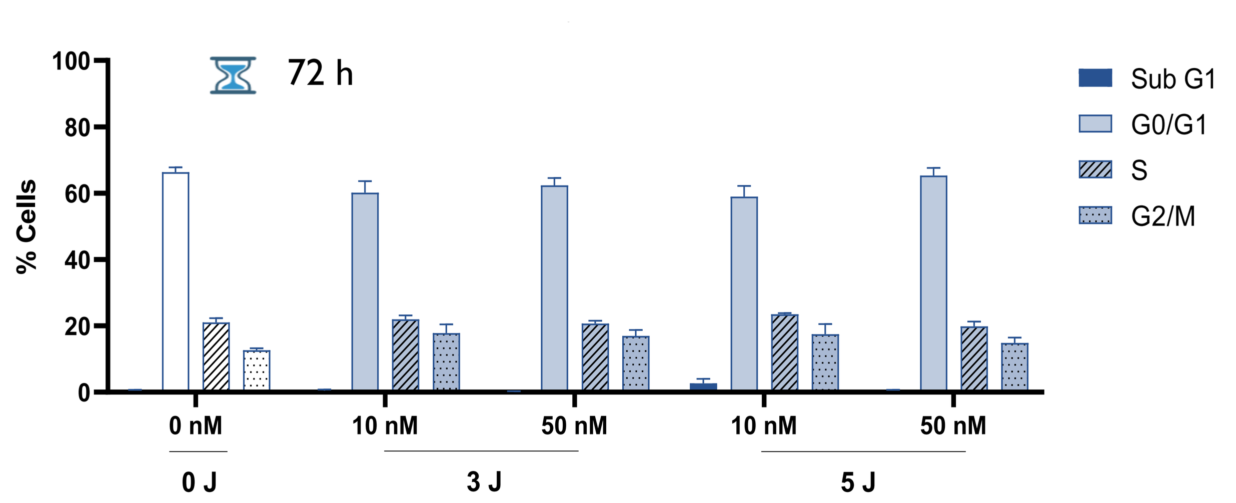
Increased protein content 24 h after treatment with **3 J** at **50 nM** and **72 h** after treatment with **3 J** and **5 J** at **all concentrations.**

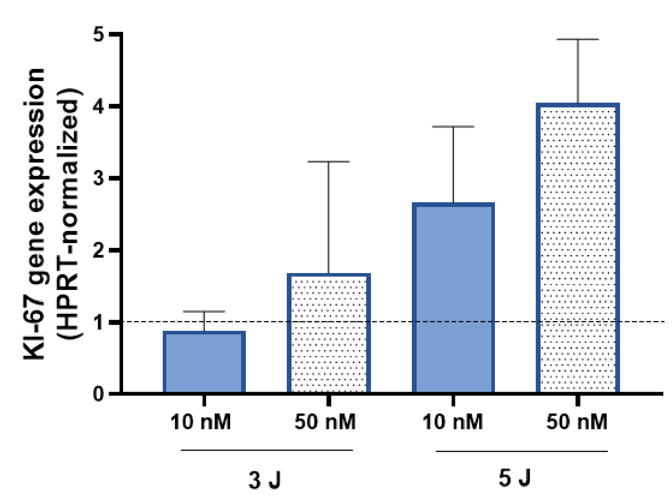


mean ± standard error; n ≥ 3; * if $p<0.05$, ** if $p<0.01$ and *** if $p<0.001$

The **formation of mineralized deposits increased**, **24 h** after treatment, with energy of **3 J** at **all concentrations** and **72 h** after treatment with **3 J** at **50 nM** and with **5 J** at **10 nM.**

Photobiomodulation using NIR light is capable of stimulating mitochondrial activity and ATP production through the action of cytochrome c oxidase, which is present in mitochondria (Wang Y *et al.*, 2017).

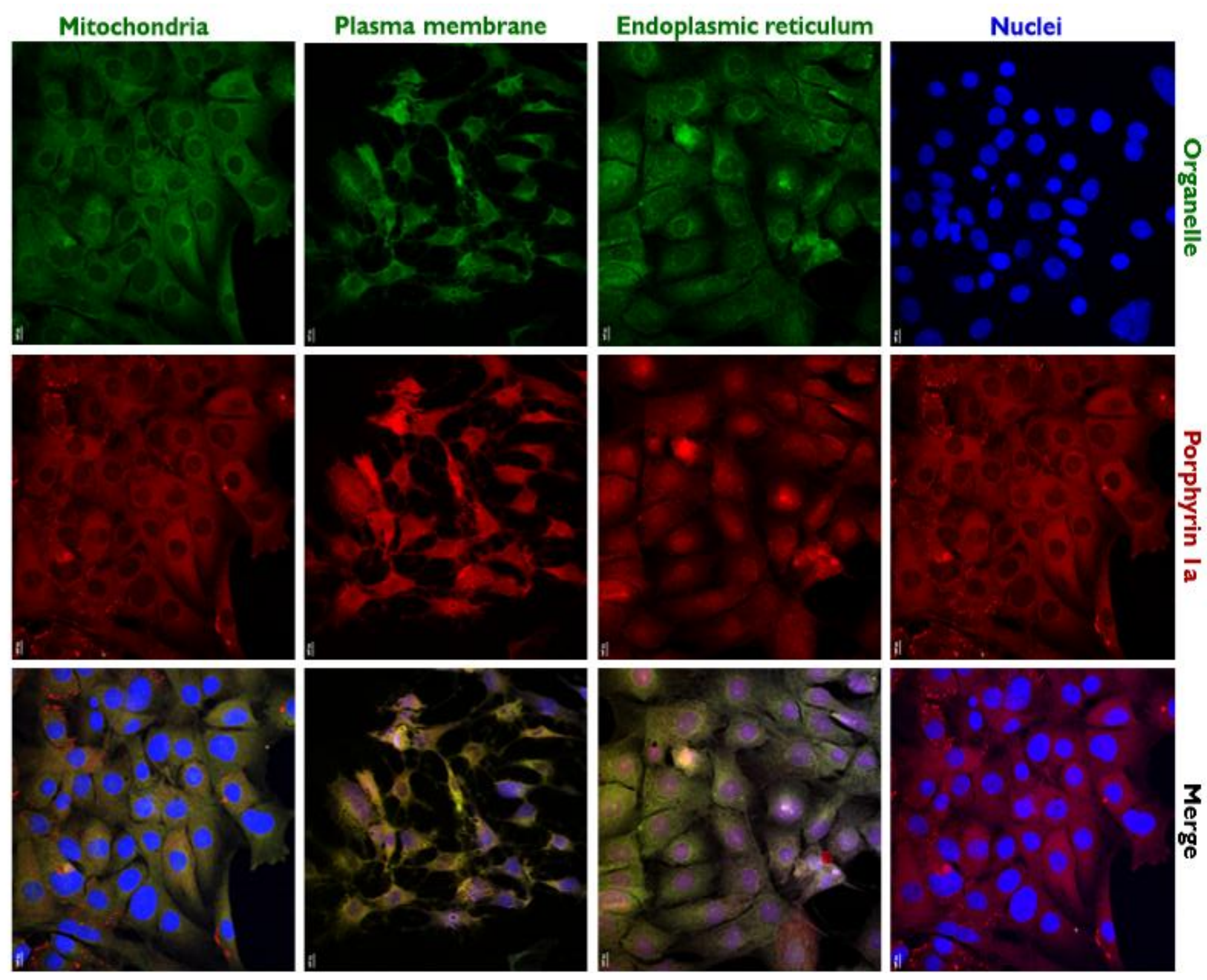




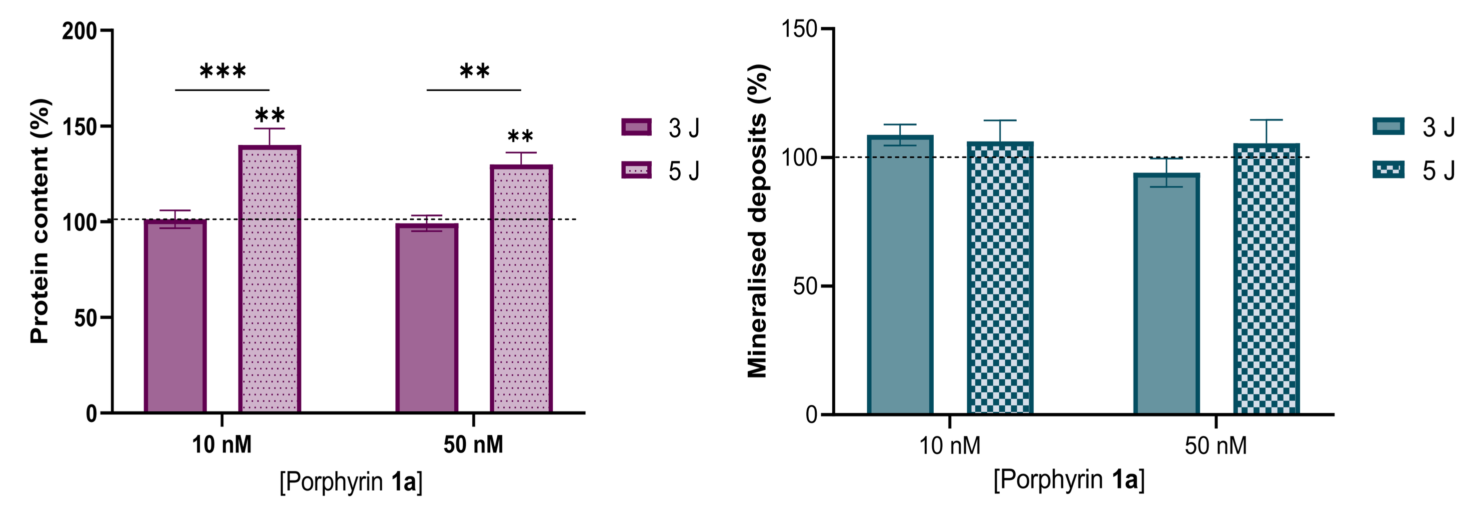
mean ± standard error; n ≥ 3; * if $p<0.05$, ** if $p<0.01$ and *** if $p<0.001$

Cells in phase G0/G1 begin the synthesis of genetic material that will be replicated in phase S (Crowley LC *et al.*, 2016).
High levels of Ki-67 expression indicate increased cell turnover and proliferation (Naharro-Rodriguez J *et al.*, 2024).

BM-MSCs



Co-localisation of **Porphyrin 1a** with the **nucleus** (33.60 ± 14.51%); **endoplasmic reticulum** (90.08 ± 6.73%); **plasma membrane** (86.83 ± 5.69%); **mitochondria** (85.85 ± 5.98%).



Porphyrin 1a at an energy of **5 J** significantly increased the **protein content** in **BM-MSCs** at concentrations of **10 nM** and **50 nM.**
Did not lead to changes in the **formation of mineralized deposits.**

Protein production by bone cells can regulate bone homeostasis and lead to bone proliferation and growth (Han Y *et al.*, 2018).

CONCLUSIONS

Overall, **PDT** promoted **cellular proliferation**, with the most pronounced effects observed under **5 J** and at **low photosensitiser concentrations.** Additional studies are required to elucidate the specific **cellular mechanisms** behind PDT-induced **proliferation and differentiation**.

CIMAGO iCBR cibb CACC Unidade Local de Saúde Coimbra FCT Fundação para a Ciência e a Tecnologia República Portuguesa CENTRO 2020 POCH União Europeia