Mathematical modelling of processes which neutralize reactive oxygen species in different types of cells

Reactive Oxygen Species (ROS) are known mainly as factors which negatively influence cells, causing aging and death. Despite the fact that they are regarded as toxic they are basic byproducts of living in an aerobic environment, and in many cases they can influence cells positively. To cope with the damaging effect of free radicals, every single cell is equipped with a number of tools and mechanisms allowing for quick neutralization of ROS, thereby protecting the cell from their harmful effects.

From my earlier studies (Ciesielska et al. 2019), it seems that different types of cells use different neutralization mechanisms, favoring one and omitting or inhibiting others. Particularly after exposition of cells to UV radiation, ROS are induced and depending on the radiation dose used they variously influence cell proliferation (cell division). Depending on the radiation dose, different effects affecting proliferation of cancer cells are observed; higher doses usually cause death but, specific to the cell type, lower doses cause stimulation of proliferation. This means that through activation of pathways responsible for regulation and neutralization of ROS, different cell types may react specifically to the same dose of radiation, thus creating possibility of different responses to the same stimulus but also different defenses against damaging effects of radiation or other factors, which in the case of tumor cells might be detrimental.

Precise knowledge of pathways regulating and neutralizing ROS is crucial for understanding the mechanisms that occur in living cells. Exclusive action of these mechanisms may influence proliferation, and it is particularly important in cancer cells. The use of mathematical models with biological data will allow to recognize different variants of cell activity in the case of using different mechanisms for neutralization of ROS. Mathematical model allowing for analysis of mechanisms neutralizing and regulating ROS may be a key element allowing for understanding of mutual interactions of ROS pathways activated in different cellular situations. Understanding of such effects in the case of cancer cells may have therapeutic relevance and may allow for better adjustment of the treatment.