Chapter 5
Role of Reactive Oxygen Species in Cellular Signalling: Insights Into Pathological Processes and Therapeutic Strategies

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ABSTRACT

ROS are molecules of the cell signalling, produced during oxidative metabolism and causes various human disease as its accumulation leads to deregulation of antioxidant defence mechanism (Wang et al. 2021). ROS regulates several cell signalling pathways which are responsible for apoptosis, survival of the cell, growth and maintenance of metabolic activities of the cell. This chapter focuses on the role of reactive oxygen species in cell signalling. Cell signalling is the process through which cell communicate each other and responds to environment and stimuli through a cascade of events, ultimately leading to production of desired protein as a result. Therefore, a comprehensive understanding of mechanism of cell signalling enhances

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our knowledge of intrinsic cellular process and also provide insight for development therapeutic strategies for curing various diseases.

INTRODUCTION

ROS are one of the most important molecules in cell signalling, increasing efficiency of cell to instantly respond to a stimulus. ROS has key role in abiotic and biotic stress sensing and encrypting different environmental signals in plants (Mittler et al. 2022). They are highly reactive and dangerous moiety. These can cause oxidative cell death. ROS defines a large group of molecules(oxidant), which have various different properties and functions. These properties and functions usually range from cell signalling to damaging cell. Hence, it is important for us to define oxidants chemically and biologically precise so that research on their functions and properties. In fact, the general term used for ROS should not be used to specify the molecules. Further, it is also important for precise measurement of oxidants, with better specificity for identification of their targets in signalling pathways (Sies et al. 2022). Although ROS are executively involved in signal (redox), but in some conditions it can cause oxidative damage. This shows that it can play both physiological and pathological role biological activities. Measurement of ROS is important to predict oxidative activities and to detect their importance in biology using antioxidant. ROS are normally understood as the byproduct of various cellular processes, shown in fig1. Cancer cell typically have higher basal level of ROS capered to normal cell, caused due to unbalanced oxidants and antioxidants. Certainly, ROS have played dual role in the metabolism for instance, when low to moderate level, ROS plays the role of signal transducer which activates cell proliferation, migration and invasion. However, when level of ROS is high, it can cause damage to proteins, lipids, membrane and nucleic acid and organelle, further this leads to death (Nakamura and Takada 2021).

Not only do they have anti-microbial activity act against bacteria and parasites but also support redox regulation of immune signalling and induction of inflammation activation. However, due to lack of in-depth data more information is unavailable (Herb and Schramm 2021). Varied ROS different cellular responses including cell death, cellular signalling and down regulation of ROS production pathway and ROS limiting pathways, these two pathways are often observed in the cancer cell. Additionally, it regulates the environment of tumor that affects the various immune responses, blood circulation and stromal cell, responsible for proving metabolic support to tumor cell. Particularly, the ROS response is extremely complex and rely on several factors such as types, severity, localisation and half-life of ROS (Cheung and Vousden 2022). Moderate increase in ROS concentration give rise to various