Chapter 7
Aging and Reactive Oxygen Species Implications for Cellular Senescence and Longevity:
Oxygen Toxicity and Aging

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ABSTRACT

Aging, a substantial cause of physical and psychosocial degradation, is attaining a significant public health concern with passage of time. It is characterized by progressive loss and delayed response of the body system followed by development of systemic complications. It enhances financial burden to the health care system. Compounding the evidences from previous reports, enhanced free radicals production mediated chronic oxidative stress along with aging process has been attributed as a specific and critical component to the etiopathology of various health complications.

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Many of the recommended interventions present only symptom-modifying effects, and a few structure-modifying effects. Thus, the present chapter aims to provide a narrative review on mystery of aging process by highlighting the complex interplay of oxidative and inflammatory stress, and orchestrate a repertoire of novel therapeutic strategies to get rid of curse of senescence.

INTRODUCTION

"Nothing is permanent in this wicked world"- Charlie Chaplin quoted these words centuries ago. (Socratic Method, n.d.) Every biomolecule, exist in nature, after a fixed time period, deteriorates with a mysterious manner. Scientists have made enormous efforts, but they have not been able to unlock the mysteries of immortality, old age and death are now considered inevitable aspects of life. Researchers now have a greater incentive to maintain individuals physically healthy and contributing members of society. Because of this, life expectancy has increased dramatically worldwide, and by the year 2050, it is anticipated that one-third of the world's population will be elderly. However, as people get older, they are more vulnerable to many ailments.

The biological phenomena of aging are a universal and inevitable process that results from a sequence of detrimental events that progressively compromise the morphology and function of the organs. Several chronic morbidities often occur concurrently with these events. (Saxena & Lal, 2006) These morbidities, which have become prevalent health issues among the elderly population, include endocrine dysfunction, immunosenescence, musculoskeletal disorders, neurodegenerative illnesses, cardiovascular disease, and diabetes. Put another way, as time goes on, aging has a detrimental effect on biomolecules and is associated with a rise in the incidence of age-related illnesses. (Pole, Dimri, & Dimri, 2016)

It's interesting to note that Haber and Willstater (1931) were the first to describe the redox reaction involving oxygen in biological systems. At that point, they identified the superoxide anion as the univalent reduce product of the molecular oxygen intermediate. (Haber & Willstätter, 1931) Haber and Weiss discovered in 1935 that when molecular oxygen underwent consecutive trivalent reduction using an iron catalyst, a highly reactive oxygen intermediate—a potent oxidizing agent—was produced. (Haber & Weiss, 1935)According to Denham Harman's free radical hypothesis of aging, which was published in 1956, the production of endogenous free radicals and the accumulated oxidative damage that free radicals generated during aerobic respiration cause to cells may be responsible for a number of changes associated with cellular aging. Beyond this notion, McCord's seminal 1974 study on synovial fluid in rheumatoid arthritis patients has gradually spawned a plethora of research