

Chapter 10

Exploring the Potentials of Antioxidants in Retarding Ageing

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ABSTRACT

In retrospect to the rise in the occurrence of ageing related disorders and the everlasting desire to overcome ageing, exploring the causes, mechanisms and therapies to curb ageing becomes relevant. Reactive Oxygen Species (ROS) are commonly generated during normal growth and development. However abiotic and biotic stresses enhance the level of ROS which in turn pose the threat of oxidative stress. Ability to perceive ROS and to speedily commence antioxidant defenses is crucial for the survival as well as longevity of living cells. Therefore living organisms are bestowed with antioxidants to combat the damages caused by oxidative stress. This chapter aims to elucidate an overview of the process of ageing, generation and enhancement of reactive oxygen species, damages incurred by oxidative stress, its amelioration strategies, therapeutic and biotechnological potentials of antioxidants and various sources of bioactive compounds significant in retardation of aging process.

INTRODUCTION

As postulated by the free radical theory of aging, exogenous administration of antioxidants may extend the lifespan of organisms provided that the main culprit behind the unavoidable aging is oxidative stress caused by imbalanced free radical reactions. Oxidative stress refers to the imbalance between oxidants and antioxidants in favor of oxidants. The term ‘oxidative stress’ may be visualized under four categories:

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1. Enhanced ROS production leading to increased oxidative load;
2. The potential for uncontrolled oxidation due to rates of production exceeding rates of metabolism;
3. Oxidative damage to cellular components; causing
4. The buildup of injured cellular components that somehow lead to loss of function and eventual death (Foyer & Noctor, 2003).

Emergence of ‘nutrigerontology’, a new scientific discipline that encompasses biogerontology, medicine, and dietetics emphasizes the severity of the need to curb the increasing rise in prevalence of aging-related diseases in recent decades (Verburgh, 2015). Even if antioxidant supplementation is receiving growing attention and is increasingly adopted in western countries, supporting evidence is still scarce. Extensive exploration of literature is still needed for better evaluation of the potential benefits from antioxidant supplementation. Organisms with high adaptability and ubiquitous presence such as cyanobacteria are bestowed with arsenals against reactive oxygen species in order to cope with various endogenous as well as exogenous stresses comprising of four lines of defense mechanisms. First line of defense is avoidance strategy which includes mat formation, migration, alterations in morphology, enclosure of filaments in amorphous silica matrices and synthesis of extracellular polysaccharides. Second line of defense encompasses scavengers which includes enzymatic and non enzymatic antioxidants. The presence of enzymatic and non-enzymatic antioxidants as natural arsenal against multiple stresses has been reported in various cyanobacterial species at their natural habitat (Kesheri, Richa & Sinha, 2011; Kesheri, Kanchan, Richa & Sinha, 2014). Third line of defense includes screening by compounds such as biopterin glucoside and photoprotective compounds. Fourth line of defense comprises of repair and resynthesis mechanisms. An enhanced understanding of oxidation mechanisms pertaining to aging process would facilitate understanding the physiological and biochemical processes involved in ageing phenomenon. The determination of reliable markers of oxidative damage and antioxidant status is a burgeoning area of research demanding extensive exploration. Moreover literature regarding the identification of a therapeutic porthole in which an eventual antioxidant supplementation may be beneficial is also scarce and requires a deeper knowledge of the antioxidant molecules which in several conditions act as pro-oxidants. In the present chapter, after a preliminary introduction to the free radical theory of aging and the underlying principle of antioxidant supplementation as an anti-aging intervention, an outline of evidence relating antioxidant supplementations with clinical conditions characteristic of older age (cardiovascular disease, Alzheimer’s disease, cancer, hyperlipidemia) will be discussed. Studies evaluating whether antioxidant supplementation might improve major outcomes of interest will also be explored. This chapter in a nutshell presents an overview of advanced as well as basic concepts regarding causes of ageing, generation of reactive oxygen species, causes of enhancement of free radicals, damages caused by increased oxidants and free radicals; amelioration strategies for oxidative stress; therapeutic and biotechnological potentials of antioxidants and various sources of bioactive compounds significant in retardation of aging process. Thus this chapter would surely enhance and help readers to understand the basics as well as advanced development in exploring the potentials of antioxidants in retarding ageing.

BACKGROUND

Biogerontological insights may be explored for dietary recommendations in order to retard the risk of various aging-related diseases that are on the rise in both developed and developing countries. There

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