Chapter 18
Role of Resveratrol (RES) in Regenerative Medicine

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ABSTRACT

Within the last quarter century, technology has been a major catalyst of the advancement in various fields of scientific knowledge, particularly medical research. This new enlightenment has spurred the exploration of alternative treatment methods to some of society's most problematic diseases. One such innovative treatment is the use of Resveratrol (RES) to treat a number of pathophysiological conditions. RES is a natural polyphenolic compound found in the skin(s) of blueberries, red grapes (a major constituent of red wine), some vegetables, and even peanuts. The compound has a number of potent regenerative properties, which include: anti-aging, anti-inflammatory, and antioxidative. Research has confirmed both in vivo and in vitro RES's beneficial applications to numerous diseases. This chapter centers on its unique healing powers and beneficial applications against myriad debilitating conditions.

INTRODUCTION

Recent scientific studies have revealed that conditions affecting the circulatory, muscular, skeletal, and other organ systems such as multiple sclerosis, heart disease, and diabetes have their origins rooted in a low-nutritious western diet. This emerging problem has led to the advancement in medical ingenuity such as regenerative therapeutics (Hubmayr 2013). For example, researchers have implemented the use of stem cells harvested from umbilical or fetal cord blood in an attempt to generate newly functional tissues (Hubmayr 2013; Bouros and Laurent 2012 ; Kolios and Moodley 2013; Liu et al. 2013; Viswanathan and Joshi 2013). Despite its potential benefits many take issue with this new technology due to the perceived unethical nature in which the cells are acquired. Therefore, research into alternative life-restoring compounds such as resveratrol (RES) and its conjugation with novel nanoparticles have presented the scientific community with a viable alternative to the mainstream medicines. RES is a naturally occurring polyphenolic compound found in the skin of red grapes, blueberries, select vegetable foods, and even peanuts (Zunino and Storms 2009; Sha et al. 2009; Kao et al. 2009; Trincheri et al. 2008; Sun et al. 2008; Shakibaei et al. 2008; Roccaro

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et al. 2008; Juan et al. 2008; Martin et al. 2004; Larrosa et al. 2003; Radhakrishnan et al. 2011). It is a powerful and versatile compound with potent regenerative properties including anti-oxidative, anti-inflammatory, and anti-aging. Combining the many beneficial properties of RES with unique nanotechnology, such as carbon nanoparticles, could give scientists the ability to enhance RES's inherent regenerative powers by increasing the stability of the compound *in vivo*, allowing it to deliver therapeutic effects over an extended period of time. Nanodiamonds (NDs) have been incorporated into the research of revolutionary drug-delivery system(s). These microscopic carbon compounds are harvested from the residue of explosive mixtures such as trinitrotoluene (TNT) and dynamite. The raw material is chemically refined and functional groups such as carboxyl (COOH), hydroxyl (-OH), and ketones (C=O) are incorporated onto the surface of the ND. This gives researchers the flexibility to conjugate a wide variety of therapeutic agents such as RES, creating an effective drug-delivery vehicle. This carrier system when introduced *in vivo* allows RES to remain intact and be released in a time-dependant manner. The agent conjugated to the surface of the ND is released only in response to a change in physiological conditions, specifically a drop in pH from basic to acidic [Hubmayr 2013; Figueiro et al. 2013; Li and Ye 2006]. This pioneering technology would allow physicians to decrease both the dosage and amount of times required to treat patient(s) suffering from debilitating conditions such as cancer. Previous clinical studies have demonstrated RES's impressive therapeutic capabilities and minimal side effects because it is a natural chemical (Mohanty et al. 2013; Liang et al. 2013; Borriello et al. 2014; Lachenmeier et al. 2014; Cottart et al. 2014). RES's natural regenerative properties and negligible toxicity makes it an extremely attractive option in the arduous pursuit for health and longevity. Many who have worked closely with RES are fascinated by its ability to operate through a variety of cellular biochemical pathways and mediate positive immune responses. Clinical data has shown that the administration of RES has restored significant functionality and vitality to target organs and tissues (Zhang et al. 2007; Sareen et al. 2007; Lee et al. 2007; Horvath et al. 2007; Hambrock et al. 2007; Gill et al. 2007; Ahmad et al. 2007).

(RES) RESTORES GROWTH OF CARDIAC STEM PROGENITOR CELLS (CSPC)

There have been numerous studies documenting RES's incredible ability to regenerate tissues. One such study investigated the effects of the application of RES to replenish degenerating cardiac tissue. As in the case of many pathophysiological conditions the common underlying cause for its manifestations is the quality of diet. The debilitating condition of diabetes mellitus is a result, among other mitigating factors, of a poor diet high in processed sugars and foods with little to no nutritive value. The onset of Diabetes can cause an imbalance in other organ systems via metabolic derangements that accompany the primary condition. Diabetic cardiomyopathy (DCM) is characterized as a disorder in the muscles of the heart which can lead to poor circulation and other complications (Delucchi et al. 2012). Evidence shows that high glucose levels leads to the hindered differentiation, migration, and adhesion of cardiac stem progenitor cells (CSPC) for the rejuvenation of worn or dying mature cardiac cells (Delucchi et al. 2012). This produces a net loss of cardiac cells because not enough new progenitor cells are able under stressful diabetic conditions to replace the cells that are lost over time. RES has been documented to restore positive growth back to the subpopulation of CSPC and improve cardiac tissue function and other model systems (Delucchi et al. 2012; Figueiro et al. 2013; Jana et al. 2009; Busanello et al. 2012; Schlachterman et al. 2008).

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