Application of an Ozone-Stressed Yeast Lysate as a Prophylactic against Ozone Induced Cutaneous Oxidative Damages

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Abstract

The knowledge of the role that ozone plays on human skin health is emerging as an important target of growing interest for cutaneous health. Ozone is a well established component of urban smog and in most cities, the levels of ozone concentrations in the air are constantly monitored as a measure of urban pollution concentrations. Early studies on ozone's effects on skin were focused mainly on the antioxidative protectants that skin expresses such as vitamins E and C and on the lipids that comprise the stratum corneum. However, more recent work suggests that while ozone itself may be too reactive to penetrate deeply into the skin, the oxidative by-products of its contact with the lipids and proteins of the skin may elicit further downstream oxidative responses, much deeper in the skin, that are equally deleterious to the skin's integrity and health. In this paper, we will discuss our efforts to examine the ability of a yeast extract developed through fermentation of *Saccharomyces cerevisiae* under conditions that expose the yeast to sub-lethal doses of ozone during the active growth phase of the fermentation process to act as a prophylactic against ozone-induced oxidative damage. Efforts to understand why this yeast works to protect skin will focus first on how very similar yeast and human skin cells respond to ozone. We will then discuss studies in which we exposed human skin equivalents to ozone, looking at the effects this free radical gas has on DNA, cholesterol and melanin and briefly include a discussion on the effects of ozone and UVB radiation in combination, to see if these two energy sources combined increase damage.

Introduction

Ozone (O_3) is a gaseous molecule that chemically contains oxygen (O_2) in combination with a powerful free radical form of oxygen called singlet oxygen (O^-)[1]. As such, ozone is actually a relatively stable storehouse for a very reactive form of oxygen that would normally be quickly converted to less reactive oxygen species. Ozone is formed in various ways, either through electrochemical transformation of molecular oxygen via electrical storms or electric current. Or, it can be produced through photochemical means by reaction of UV light with nitrous oxides and oxygen in the air. Through the latter method of production, ozone is produced in urban locations where smog from automobiles and other exhaust-producing combustion devices create it as a by-product of inefficient hydrocarbon burning. Most large urban cities monitor ozone as a measure of degrees of air quality and pollution. In the United States, eight hour exposures to ozone should be limited to 0.1 ppm to avoid adverse health risks but levels in certain urban areas can exceed 2.0 ppm on occasionally bad pollution days[2]. Exposure of humans to ozone has even been linked to reductions in sperm counts in human males[3].

Whilst exposure to extremely high levels of ozone is rare in urban areas, on the other hand, constant exposure to low levels of the gas is impossible to avoid and unlike exposure to UV light, it is difficult to shield oneself from this ubiquitous gas. Early research into the effects of ozone on skin was preceded by significant work looking at the effects of this gas on the lungs and respiratory tract. It was established early on that ozone was extremely corrosive to the natural surfactants that line the respiratory tract and environmental warnings and exposure limits were based on the levels of the gas known to cause damage to the respiratory tract. Even the body's powerful immune response is influenced by exposure to ozone. Only recently has the role of ozone on cutaneous damage begun to be explored. Early pioneering work by Lester Packer and Jans Thiele showed that ozone will affect cutaneous targets such as vitamins E and C and the lipids which comprise the stratum corneum lipid barrier. Some of the early work is