Cold Plasma induced structural modification of NADPH oxidase activator (Noxa 1) by oxidative stress

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The use of cold atmospheric plasma (CAP) increases for the diversity of medical applications, such as sterilization, wound healing, blood coagulation, and cancer treatment. CAP interacts with the oxygen, nitrogen, water, etc. in air, to produce various radical and non-radical species, for example, hydroxyl radicals (•OH), superoxide ($O_2^{\bullet-}$), singlet oxygen ($^1O_2$), nitrogen dioxide (NO_2), hypochlorite (ClO^-), atomic oxygen (O), and nitric oxide (NO). During the plasma–liquid interactions, some relatively long lifetime reactive species are generated in liquid, such as hydrogen peroxide (H2O2), nitrites (NO2−), and nitrates (NO_3^-) [1]. In order, to understand the CAP mechanism on the complex bio-organism it is important to understand CAP action on the proteins. Therefore, we have studied the effect of CAP on the redox protein, NADPH oxidase1 (Nox 1) [2,3]. NADPH oxidase (NOX) enzymes produce superoxide that have much wider physiological functions in cells such as cell differentiation, growth, and proliferation, embryonic development and tissue regeneration, and development [3]. Therefore, in this paper, we demonstrate the effect of cold atmospheric plasma (CAP) on the structural changes of Noxa1 SH3 protein, one of the regulatory subunits of NOX1. For this purpose, firstly we purified the Noxa1 SH3 protein and analyzed the structure using X-ray crystallography, and subsequently, we treated the protein with CAP for different time intervals. The structural deformation of Noxa1 SH3 protein was analyzed by various experimental methods (circular dichroism, fluorescence, and NMR spectroscopy) and by MD simulations. Additionally, we demonstrate the effect of CAP on the viability and expression of NOX1 in A375 cancer cells. Our results are useful to understand the structural modification/oxidation occur in protein due to reactive oxygen and nitrogen (RONS) species generated by CAP.

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