Targeting Oxidative Stress with Functional Polymer

Haijiao Liu

Oxygen is a sword with double blades. On the one hand, it is needed for all the aerobic organisms to produce cellular energy: adenosine-5-triphosphate (ATP); on the other hand, reactive oxygen species (ROS) are generated as by-products when oxygen is reduced to water along the mitochondrial electron transport chain. ROS molecules, like superoxide anion ($O_2^{\cdot -}$), hydrogen peroxide (H_2O_2) and hydroxyl radical ($^{\cdot}OH$) are highly reactive and will attack biomolecules like protein, lipid and DNA.

Under this constant ROS attack, organisms use intrinsic antioxidant defense to detoxify ROS and protect themselves. When intrinsic antioxidant defense is overwhelmed by elevated ROS, oxidative stress occurs.

ROS have several negative effects and one of them is lipid peroxidation. In this process, oxidation of polyunsaturated fatty acids generates many highly active products like Malondialdehyde (MDA), 4-hydroxy-2-nonenal (4-HNE), 4-hydroxy-2-hexenal (4-HHE) and acrolein. Among them, acrolein shows highest activity towards nucleophile residues in proteins, lipids and DNAs.

In environment, acrolein is generated during the combustion of fuel, tobacco, and even cooking oil. Acrolein attacks nucleophiles in amino acids and can be readily incorporated into proteins and forms carbonyl adducts. It has been proved that oxidative stress, ROS and acrolein are associated with a lot of diseases like Parkinson's disease, Alzheimer disease, inflammation, cancer, aging etc. Above all, acrolein serves a good target for eliminate oxidative stress.

In this project, we tried to explore if polymer syr 48, polyvinyl alcohol (PVA) with hydrazide groups, can scavenge acrolein or acrolein medicated oxidative stress *in vitro*. The result showed that the polymer can scavenge acrolein and acrolein-protein adducts in a medium free environment. However, the scavenging effect of the polymer against acrolein and carbonyl adducts is limited when medium is present and this is probably due to the competition between the polymer and proteins existing in the medium.