Synopsis of Original Research Paper

A novel antioxidant system based on lipid assemblies-mediated decomposition of reactive oxygen species

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The structure and function of phospholipids are modified in the presence of reactive oxygen species (ROS) such as hydrogen peroxide. An excess amount of the ROS is known to be decomposed enzymatically with catalase. To our knowledge, little is known on the role of phospholipid molecules in decomposing the ROS in the absence of the enzyme. In the present work, the decomposition of hydrogen peroxide at the initial concentration of 1.0 mM was examined at pH 7.4 in the presence of the various molecular assemblies of phospholipids. Phospholipids used were various phosphatidylcholines (PC) which were different in the number of carbon atoms in the acyl chains n as well as the degree of unsaturation. The saturated PCs ($n < 10$) forming monomers and micelles slightly enhanced the decomposition of hydrogen peroxide. In marked contrast, the PCs forming liposomes ($10 \leq n$) significantly enhanced the decomposition reaction with neither lipid peroxidation nor change in the size of liposomes. Therefore, the liposomes were suggested to undergo negligible physicochemical modifications in the presence of hydrogen peroxide. The steady-state fluorescence polarization of the probes incorporated in the liposome membranes was measured to clarify an effect of hydrogen peroxide on the fluidity of liposome membranes. The fluidity of the lipid-water interface in the liposomes was decreased by the presence of hydrogen peroxide. On the other hand, practically no effect of hydrogen peroxide was seen on the fluidity of the hydrophobic region in the membrane. These results obtained indicated that the liposome-mediated decomposition of hydrogen peroxide proceeded at the lipid-water interface of liposomes. In conclusion, it was revealed that the phospholipid bilayer membranes forming liposomes functioned as a novel antioxidant system which effectively decomposed hydrogen peroxide.