611/E2

A kinetic study of photodegradation of lycopene in water/acetone solutions

D D D H Alwis[1,2,3], W M K M Ratnayake[2], U G Chandrika[2] and P M Jayaweera[1*]

[1]*Dept. of Chemistry, University of Sri Jayewardenepura, Nugegoda*
[2] *Dept. of Biochemistry,University of Sri Jayewardenepura, Nugegoda*
[3]*Dept. of Chemistry, The Open University of Sri Lanka, Nugegoda*

Lycopene ($C_{40}H_{56}$) is an acyclic unsaturated carotenoid which can be easily degraded *via* photo and thermally induced *cis-trans* isomerization and oxidation reactions. Exposure of living cells to UV light leads to the generation of reactive oxygen species (ROS). These ROS interfere with the normal functioning of biological systems and may be associated with the risk of cancer, atherosclerosis, cardiovascular diseases and cataract. Lycopene has been reported to show remarkable antioxidant activity and this is mainly due to the presence of conjugated double bonds in the structure. Medicinal uses of lycopene have been reported in the literature. Nevertheless, photostability of lycopene and the health effects of photoproducts have not been investigated in depth up to date. Therefore, an extensive understanding of the photostability of lycopene in mixed solvent systems is essential. This is mainly because the excited state of lycopene is more polar in nature than its ground state. In this work, the photostability of lycopene, extracted from watermelon was studied in acetone and in four different solutions of water in acetone mixtures i.e. 5%, 4%, 3% and 2% v/v.

The decay curves of absorbance verses time were plotted and the data were used to understand the kinetics of photodegradation. The results indicate that the rate of photo-degradation gradually decreases with increase in percentage of water. Analysis of data shows that the kinetics of lycopene photodegradation in pure acetone follows first-order reaction kinetics, whereas, for the water in acetone solutions, decay follows second order kinetics. Therefore, the stability of lycopene towards UV light in the presence of small amounts of water can be used to prevent the loss of color and quality of lycopene containing foods. The enhanced stability in the presence of water could be explained with the support of previously published work. Water interacts with the radical cation of lycopene ($Lyco^{\bullet+}$) that is formed during photo-induced decomposition. Further water molecules act as a proton acceptor to generate the lycopene radical through a deprotonation mechanism, which in turns dimerizes: $2Lyco^{\bullet} \rightarrow Lyco_2$. This may also be due to the fact that water stabilizes the excited state more than the ground state in polar solvents, for excitations involving $\pi^* \leftarrow \pi$ transition. A similar behavior was observed in a previous study carried out for β-carotene.

pradeep@sjp.ac.lk Tel: 0112758457