

Electrochemical Behaviors of Xanthene Red Food Colorants

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Jun Yano, Rie Kamiji, Tomone Amatubo and Kunitoshi Yoshihira

Department of Engineering, University of East Asia

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Abstract

The cyclic voltammograms of the xanthene food colorants (Food Red Nos. 3, 104, 105 and 106) were firstly measured. The anodic current peaks are evident in all the cyclic voltammograms. The peaks originate from Food Red Nos. 3, 104, 105 and 106, themselves. The reduction activity becomes higher in the order, Food Red Nos. 3, 105, 104, 106, because of the order of the anodic peak potentials: +0.725 V for Food Red No. 3, +0.801 V for Food Red No. 105, +0.810 V for Food Red No. 104 and +1.01 V for Food Red No. 106. In addition, the difference of the peak potentials is due to the electronic inductive effect of the ring-substituted functional groups.

No cathodic current peak of the colorants was observed in the cyclic voltammograms even when the cathodic potential was swept to -0.5 V. This implies that the cation radicals or dications of the colorants generated in the anodic potential sweep are so unstable that they react with the colorants themselves or water, and the cation radicals or dications are transformed into redox inactive species which cannot be retransformed into the original colorants.

When Food Red Nos. 3, 104, 105 and 106 were electro-oxidized at constant potential of + 1.1 V in aqueous electrolytic solution, the concentration of the colorants decreased. During the electro-oxidation, both the cyclic voltammograms and the absorption spectra were measured at desired electrolytic times. Only the anodic current peaks of the colorants themselves was observed in the cyclic voltammograms, implying that the products from the colorants had no redox activity. Also, the absorption spectra had little difference before and after the electro-oxidation. However, red solid products were obtained from the electro-oxidizing solution. The products are probably polymers derived from the colorants, although the molecular structures have not yet been determined.

Food Red Nos. 3, 104, 105 were functioned as antioxidants because the anodic potentials were lower than the cathodic potential of the reduction of oxygen, although the ability of the antioxidants were lower than that of a typical antioxidant, BHA.