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The antioxidant action of vitamins during the electrodegradation of Brown HT additive

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Abstract:
The electrochemical behavior of the Brown HT dye is studied by two electrochemical methods; cyclic voltammetry and electrolysis at constant current density, in association with UV-Vis spectrophotometric analysis. The study highlights the antioxidant role of vitamin A-palmitate, vitamin C and vitamin E-acetate on the electrochemical degradation processes of Brown HT dye. The study shows that all three vitamins have a retarding effect on the electrochemical degradation of Brown HT dye, and among these the most pronounced is that of vitamin C.

Keywords: Brown HT, electrochemical degradation, vitamins, antioxidants

1. INTRODUCTION

Brown HT is used to replace cocoa or caramel as a colorant mainly in flour, chocolate cakes, but can also be found in sugar confectionery, fruit products, fish, canned meat, ice cream and sauces and other products, including pills [1-6]. The dietary level as well as the toxic effects of this food additive are controversial and at the same time contradictory topics. Absorption, metabolism and excretion of the dye additive are dose-dependent and for doses between 50 and 250 mg/kg bw it was observed to be almost completely eliminated within 72 hours [6,7].

The use of the Brown HT additive in industries important to human health (pharmaceutical, food, cosmetic) has imposed strict regulations on its rational use. Thus, methods for its determination or degradation have been developed such as spectrophotometric, chromatographic and electrochemical methods [8-11].

This study presents the experimental results on the electrochemical degradation of the food coloring additive Brown HT in a simulated aqueous environment in the presence of vitamins (A-palmitate, C and E-acetate) and chloride ions using platinum electrodes.

2. MATERIALS AND METHODS

Sodium chloride used as the supporting electrolyte and vitamins A, C, and E were purchased from Merck and were of analytical and pharmaceutical grade, respectively. The food additive Brown HT was procured from a local confectionery. Inert platinum electrodes with a purity of 99.99% were in the form of plates with a surface of 1 cm^2.

The study of the electrochemical behaviour of Brown HT was carried out using two electrochemical methods, cyclic voltammetry and electrolysis at constant current density coupled with UV-Vis spectrophotometric analysis. All experiments were performed at room temperature under a dynamic stirring regime at 300 rpm.

3. RESULTS AND DISCUSSION

3.1. Electrochemical behaviour of Brown HT in the absence of vitamins

Through the comparative study by cyclic voltammetry, significant differences were found at high values of the potentials of the working electrode, respectively high values of the current densities. The chemical and electrochemical degradation processes of the Brown HT dye depend on certain experimental parameters, such as pH, the presence of catalysts, the nature and composition of the electrolyte solution. In the presence of organic molecules of the Brown HT dye the values of the current densities are lower due to the adsorption of dye molecules on the electrode surface.

3.2. Electrochemical behaviour of Brown HT in the presence of vitamins

The electrochemical degradation of Brown HT is achieved both directly through the participation of dye molecules in the charge transfer processes at the electrode surface, and indirectly through the oxygenated species of chlorine inside the electrolyte solution. The UV-Vis spectra of electrolyte solutions subjected to electrolysis at constant current density show a delay in the electrochemical degradation of Brown HT food additive. When vitamin C is present in the electrolyte solution, the increase in current densities indicates an intensification of the electrode processes. In the experimental conditions used, it was observed that in the presence of vitamin E molecules, the current densities present high values, this is explained considering the strong hydrophilic nature of vitamin E; vitamin E exhibits a stronger adsorption on the surface of the platinum electrode.

4. CONCLUSION

Cyclic voltammetry study indicates the formation of electrochemically active chlorine species. The experimental voltammetric results show the participation in the electrode processes of the supporting electrolyte, Brown HT additive molecules and vitamin molecules (A-palmitate, C and E-acetate). The variation of the degree of electrochemical degradation (ED) shows that the presence of vitamins in the electrolytic solution results in a decrease in ED values, the obtained results show that vitamin C has the most pronounced effect.

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