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Inhibition mechanisms of the browning process in vegetables and fruits by various inhibitors

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Ascorbic, citric and various amino acids i.e. cysteine, glycine, valine, metaionine and phenylalanine were examined as antibrowning agents and/or browning promoters. Mechanisms of the effects of each compound on the browning process were investigated and discussed. Ascorbic acid, citric acid and cysteine reduced significantly both the browning process and PPO activity. Browning index gave strong correlation with PPO activity (r2=0.96, n=19) indicating that the browning process is mainly enzymatic. Ascorbic acid could reduce the formed quinone instantly to the original substrate (catechol) at high concentration (>1.5%) while at lower concentrations acted as competitive inhibitor (KI=0.256 ±0.067 mM). Cysteine, at higher concentrations (≥1.0%), reacted with the resulted quinone to give a colorless products while at the low concentrations, cysteine worked as competitive inhibitor (KI=1.113±0.176 mM). Citric acid acted only as PPO non-competitive inhibitor with KI=2.074±0.363 mM. The products of PPO-catechol-cysteine reaction could be separated and identified by LC-ESI-MS. Results indicated that quinone undergoes two successive nucleophilic attacks by cysteine thiol group. Cysteine was condensed with the resulted mono and dithiocatechols to form peptide side chains.

The examined amino acids, except for cysteine, showed conflict effects. High concentrations (≥100 mM for glycine and ≥1.0 M for valine, metaionine and phenylalanine) induced potato browning while lower concentrations reduced the browning process. In PPO assay, high concentrations (≥1.11 mM) of the four amino acids developed more color than that of control samples. Visible spectra indicated a continuous condensation of quinone and glycine to give colored adducts absorbed at 610-630 nm which were separated and identified by LC-ESI-MS as catechol-diglycine adduct that undergoes polymerization with other glycine molecules to form peptide side chains. In lower concentrations, the less concentration the less developed color was observed.

Biography

Hussein M Ali obtained his Master's degree in Biochemistry from Agricultural Biochemistry Department, Ain Shams University, Egypt in 1982. He has obtained PhD in Organic Chemistry from Michigan State University, USA in 1990. He is the Professor of Chemistry in Agricultural Biochemistry Department, Ain Shams University, Egypt (2000-present), and Head of the Department (2007-2010). He is the member of the Permanent Scientific Committee of Promoting Professors and Associate Professors Egypt (2008-2010) and Visiting Professor at Umm Al-Qura (1994-2000) and Dammam Universites (2010-2015) SA. He is the regular referee of some reputed journals (IF 2.0-4.0). His research experience includes Agricultural & Food Chemistry, Enzyme Kinetics & Inhibition, Computational Chemistry, QSAR and Spectroscopy. He has published >40 papers, most of them in international journals with IF 1.0-4.5.

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