The Study of Flavonoid Interaction with Carbon Quantum Dots (CDQs) as the Basis for the Fluorometric Point-of-Need Flavonoid Quantification

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Abstract:

The quantification of flavonoids is needed for various products, including raw plant materials, foods, pharmaceuticals, cosmetics, perfumes and the by-products of various industries. The conventional colorimetric method for measuring total flavonoid content by use of Al3+ salts is inexpensive and easily performed, but its results depend on the chemical structure of the analytes. We studied the interactions between two kinds of carbon quantum dots (CQDs), and a selection of flavonoids alone and in complex with Al^{3+}. Fluorescent CQDs were produced by the microwave-assisted method from L-cystein ($_{cys}$CQD with blue emission) and from citric acid and urea (curCQD with green emission). Quercetin, rutin (quercetin-3-O-rutinoside) and taxifolin (dihydroquercetin) were used as analytes at concentrations of 0.01-1 μM. Quercetin and rutin caused effective quenching of visually detected CQDs fluorescence at concentrations of 0.1-0.3 μM for $_{cys}$CQD or 0.3-0.5 μM for $_{cur}$CQD. The quenching action of taxifolin is markedly lower than of quercetin or rutin. Aluminium chloride prevented quenching of CQDs fluorescence and caused a right shift of emission spectra in triple complexes CQD+quercetin+Al^{3+} at excitation wavelengths of 365 nm. We suppose that this effect can be due to the Förster resonance energy transfer (FRET) from CQDs to quercetin+Al^{3+} complex. Both the CQDs fluorescence quenching by flavonoids and FRET-mediated emission wavelength shift could be used for the non-instrumental fluorometric point-of-need flavonoid quantification