Studies on photoluminescence method for determination of quercetin using CdSe/ZnS quantum dots

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Quercetin is a plant flavonoid present in numerous food products like tea, apples, onion, raspberry and many others. Quercetin shows many biological activities including cardiovascular protection, anticancer, antiviral, antiallergy and anti-inflammantory activity. Biological effects of quercetin are still intensively studied and for this reason there is demand for simple, fast and sensitive methods of this flavonoid determination.

Quantum dots (QDs) are semiconductor nanocrystals with diameters of between 1 and 100 nm, that show many special physical properties associated with quantum confinement effects. Those effects are responsible for their intrinsic properties such as the size-dependent wavelength of their photoluminescence. It was reported that electron/hole acceptors absorbed on the QDs surface exhibited efficient quenching effects on the QDs PL intensity. This effect was used for simple phenols (phenol, dopamine, hydroquinone) and benzoquinone determination.

The aim of the current study was to develop and validate a quantum dots-based photoluminescence method of quercetin determination. A CdSe/ZnS quantum dots with polymer coating and carboxyl surface groups were utilized. In the presence of quercetin the photoluminescence of quantum dots was markedly increased and the increase of the emission was linear up to 100 µM of flavonoids. The highest signal to noise ratio was recorded at the temperature 10 °C, pH 11 and concentration of quantum dots 0.8 pM. Limit of detection amounted to 3 µM and was lower in comparison to popular spectrophotometric method of flavonoids determination based on the reaction with $AlCl_3$. Quercetin was succesfully selectively determined in the presence of interfering species: glucose, ascorbic acid and rutin. Quercetin was also determined in the water/methanol (60/40 v/v) extract of quercetin obtained from yellow and red onion. It was found that matrix may affect the intensity of photoluminescence when quercetin is detected in crude plant extracts.

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