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Enhanced sensitivity to detection nanomolar level of Cu^{2+} compared to spectrophotometry method by functionalized gold nanoparticles: design of sensor assisted by exploiting first-order data with chemometrics

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Abstract

A simple, sensitive and efficient colorimetric assay platform for the determination of Cu^{2+} was proposed with the aim of developing sensitive detection based on the aggregation of AuNPs in presence of a histamine H2-receptor antagonist (famotidine, FAM) as recognition site. This study is the first to demonstrate that the molar extinction coefficients of the complexes formed by FAM and Cu^{2+} are very low (by analyzing the chemometrics methods on the first order data arising from different metal to ligand ratio method), leading to the undesirable sensitivity of FAM-based assays. To resolve the problem of low sensitivity, the colorimetry method based on the Cu^{2+}-induced aggregation of AuNPs functionalized with FAM was introduced. This procedure is accompanied by a color change from bright red to blue which can be observed with the naked eyes. Detection sensitivity obtained by the developed method increased about 100 fold compared with the spectrophotometry method. This sensor exhibited a good linear relation between the absorbance ratios at 670 to 520 nm ($A_{670/520}$) and the concentration in the range 2-110 nM with LOD = 0.76 nM. The satisfactory analytical performance of the proposed sensor facilitates the development of simple and affordable UV-Vis chemosensors for environmental applications.