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Case Report

Surface plasmon resonance based colorimetric probe for vitamin B_1 detection: Applications to bio-fluid analysis

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ABSTRACT

This study reports simple analytical approach for thiamine (Vitamin B_1) detection based on induced aggregation and alternation in colorimetric properties of gold nanoparticles (AuNPs), which was synthesized through citrate reduction approach. Furthermore, the citrate capped AuNPs are characterized by various analysing tools. The addition of thiamine persuades the aggregation of citrate-AuNPs and further leading to red to blue colour transition with decrease in absorbance intensity. The proposed method achieves good linearity with a correlation coefficient of 0.9843. By using our proposed strategy, thiamine was detected by unassisted vision as well as absorption spectroscopy. Under the most favorable condition method achieves good linear relationship between concentration range 0.01–0.8 μg mL^{-1} with limit of detection of 0.0067 μg mL^{-1}. Under the premium condition, the method offers excellent selectivity towards thiamine detection in presence of different interfering species. Further practical applicability of the method was checked by using blood serum and urine sample via standard addition method. The obtained recoveries were acceptable in the range of 98.70–102.97% for added thiamine concentration. Thus, the proposed method may emerge as a target specific and highly sensitive tool towards thiamine detection.

1. Introduction

Vitamins are one of the most required micronutrient for human body to work properly. Anabolic processes do not produce some vitamins, food and medicines are good candidate to provide it [1]. B complex is a combination of Vitamin B_1, B_6 and B_{12} and important participant in various functions of metabolism and excess or deficiency of vitamins causes specific diseases [2]. However, amongst the B complex, vitamin B_1 (thiamine) is considered as an important nutrient to maintain the neural activities. Vitamin B_1 contains amino pyrimidine, thiazole ring and methyl, hydroxyethyl side chain with thiamine hydrochloride. Animal and plant tissues are the major sources of thiamine. Thiamine is water soluble organic compound and in the form of pyrophosphate it

acts as a coenzyme. Thiamine coenzyme named as Thiamine Pyrophosphate (TPP) takes part in carbohydrate metabolism and requirement is depend on content of carbohydrate in diet [3]. Thiamine is an effective catalyst for the reactions which converts sugar to energy in blood. Beriberi disease arises by thiamine deficiency is due to intake of thiamine deficit polished rice [4]. Weight loss, discomfortness, mental confusion and irritability are the indications of an untreated thiamine deficiency [5]. So driven by the need it is crucial to construct rapid, accurate and precise method for detection of thiamine to monitor its level regularly. Hence, we developed simple, sensitive, specific and unassisted vision probe for thiamine detection. Methods developed so far includes capillary electrophoresis [6], thin layer chromatography [7], electrochemical analysis [8] and HPLC [9]. Nevertheless, these