Point-of-care detection of *Salmonella* in food and water using an optical aptasensor based on g-C_3N_4@Cu_2O composites

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First I. Afrooz Tarokh[1], Azam Bagheri Pebdeni[2], Morteza Hosseini[3]

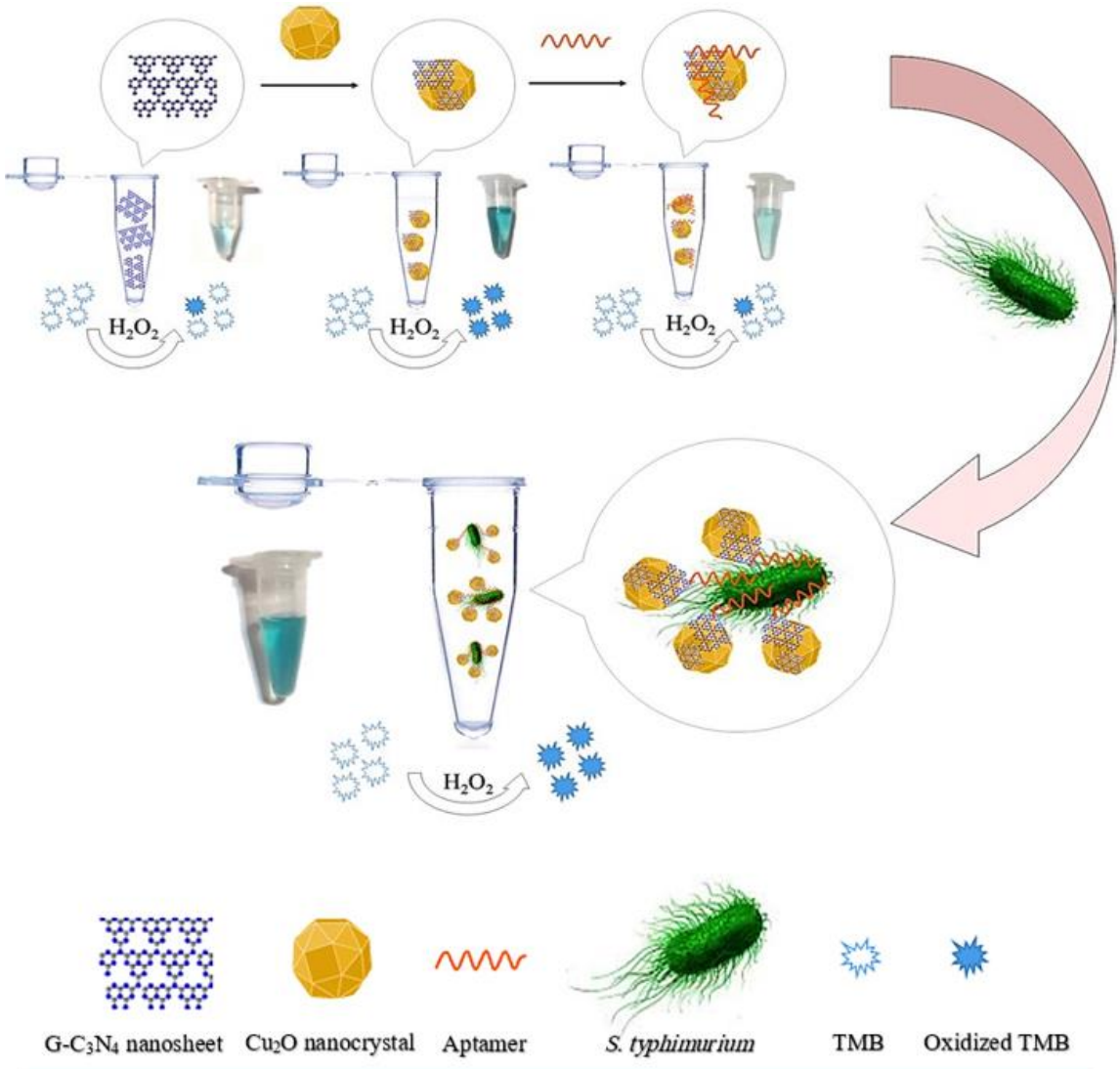
[1]Department of Life Science Engineering, Faculty of New Sciences & Technologies, University of Tehran, Tehran, Iran
[2]Department of Life Science Engineering, Faculty of New Sciences & Technologies, University of Tehran, Tehran, Iran
[3]Department of Life Science Engineering, Faculty of New Sciences & Technologies, University of Tehran, Tehran, Iran

BACKGROUND: Food borne diseases are not only one of the leading causes of death worldwide, but also a serious obstacle to socioeconomic development of countries. These diseases are mainly caused by consumption of food, water or other beverages contaminated with some pathogens, which can be transmitted through the digestive system. Among these pathogens, the importance of *Salmonella* is undeniable, since it has been known as the leading cause of foodborne bacterial infections in many countries for at least recent 100 years. Accordingly, a new colorimetric aptasensor equipped with a novel composite of graphitic carbon nitride (g-C_3N_4) nanosheets and copper oxide (I) (Cu_2O) nanocrystals was presented for detection of *Salmonella typhimurium* (*S .typhimurium*).

METHOD: A composite of g-C_3N_4 nanosheets and Cu_2O nanocrystals was employed as an optical biosensor in which *Salmonella*-aptamer could identify the presence of *S .typhimurium*. In fact, the dual-purpose structure of this composite could simultaneously contribute to superb peroxidase-like activity and interaction with label-free aptamer. Although g-C_3N_4@Cu_2O could effectively create a visible blue color following the oxidation of 3,3′,5,5′-tetramethylbenzidine (TMB) in presence of hydrogen peroxide (H_2O_2), this catalytic activity of composite was severely decreased after the interaction with aptamers.

RESULTS: Following the presence of *S. typhimurium* in sample, aptamers bound to their specific target. subsequently, catalytic activity of g-C_3N_4@Cu_2O was enhanced in proportion to *S. typhimurium* concentration. Under optimized conditions, this aptasensor exhibited an excellent detection performance in a range from 1.5×10^1 to 1.5×10^5 CFU/mL(Fig 1), with the detection limit of 15 CFU/mL. Furthermore, portable detection of *S. typhimurium* using the paper-based model of this method was successfully performed in just 6 min (Fig.2).

CONCLUSION: Analysis of spiked milk samples revealed high potency of this method as an ultrasensitive, rapid and label-free promising tool for *S. typhimurium* detection.



Scheme 1 Schematic illustration of colorimetric aptasensor for *S. typhimurium* detection

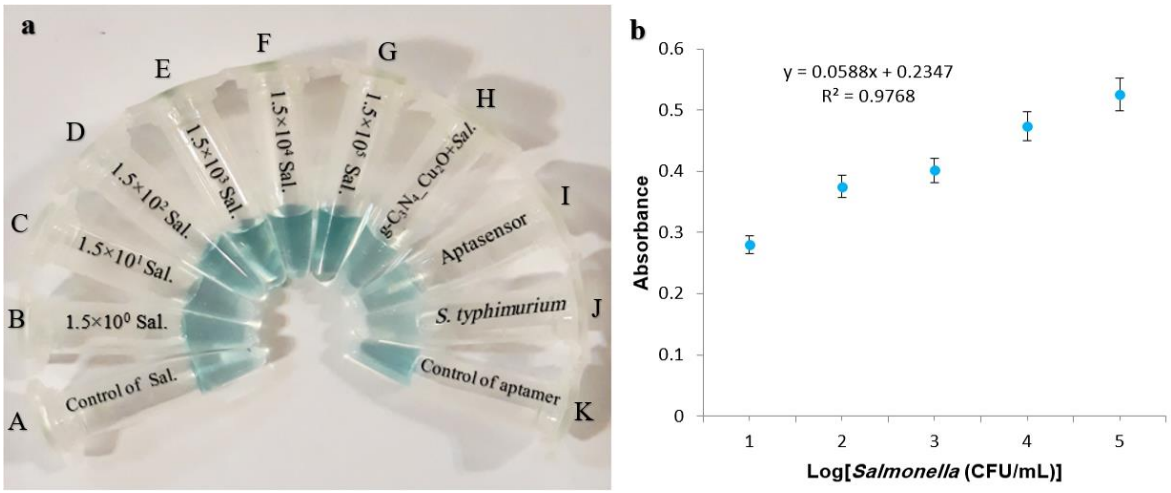


Figure 1. Positive correlation between the intensity of blue color, the absorbance and the logarithm of different concentration of *S. typhimurium* within the range of 1.5×10^{1} to 1.5×10^{5} CFU/mL

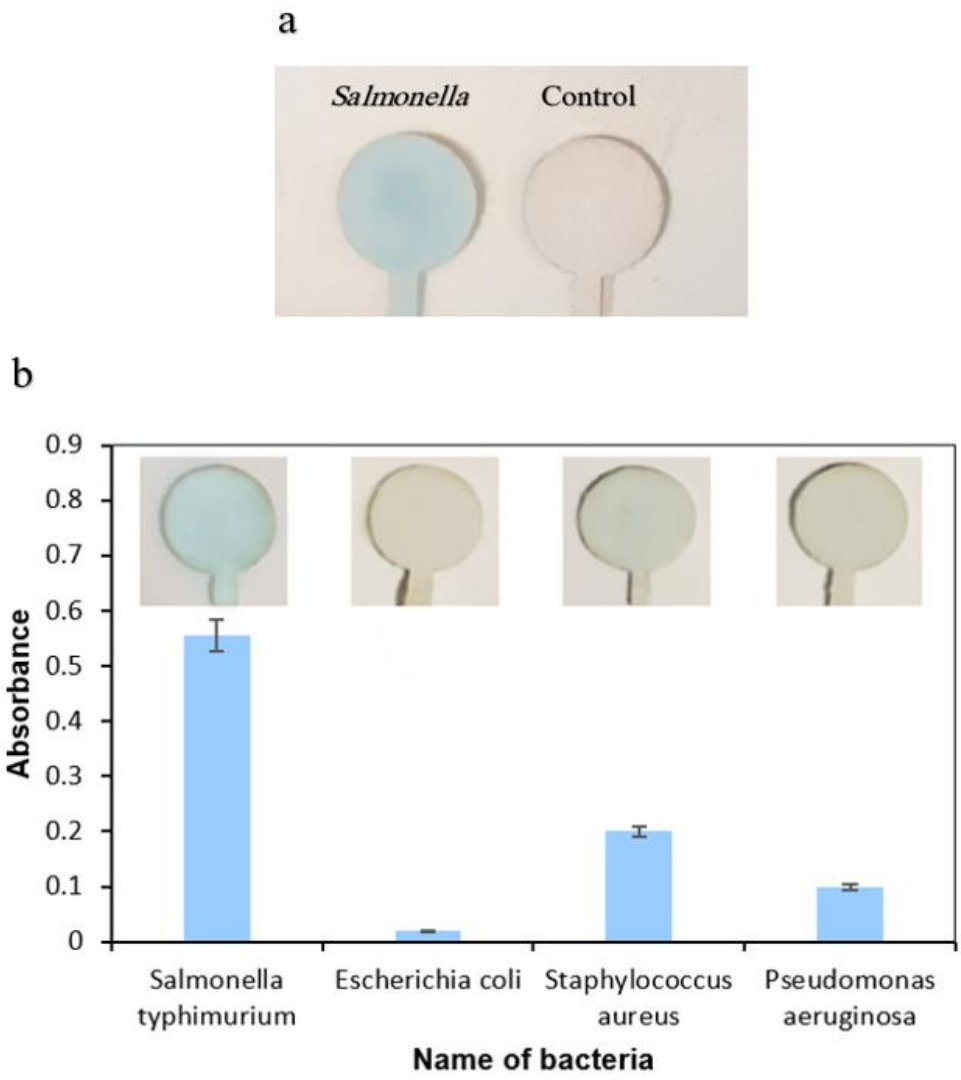


Figure 2. a) Paper-based detection of *S. typhimurium*, b) Selective detection of *S. typhimurium*