Supporting information

Non enzymatic colorimetric detection of glucose using cyanophenyl boronic acid included β-cyclodextrin stabilized gold nanoparticles

Priya A. Nair and K. Sreenivasan*

Laboratory for Polymer Analysis, Biomedical Wing, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Poojapura, Thiruvananthapuram-695012, Kerala, India

*Tel.: +91 4712520248; fax: +91 4712341814

E-mail: sreeni@sctimst.ac.in (K. Sreenivasan)

Table S1: Comparison Table for latest literature

Probe material	Sensing mechanism	Detection limit
3-aminophenyl boronic acid coupled gold nanopartilces [1]	Colorimetric sensing	0.1 mmol/L to 9.8 mmol/L at pH 6, 0 to 6.5 mmol/L at pH 9
Calix [4]arene/phenyl boronic acid functionalized gold nanopartilces [2]	Colorimetric sensing	5 to 100 nM
Copper oxide nanoparticles [3]	Electrochemical sensing	5 µM to 2.3 mM
Gold nanoparticle assisted silver mirror reaction [4]	Colorimetric sensing	0.04 mM to 1 mM
Gold nanoparticle chitosan composite film [5]	Electrochemical sensing	4.00×10^{-4} mol/L to 1.07×10^{-2} mol/L
Silver nanoparticles/carbon nanotubes/chitosan film with horseradish perroxidase and glucose oxidase [6]	Amperometric sensing	0.5 to 50 µM
Silicon dioxide coated grapheme oxide nanosheets decorated with Ag nanoparticles [7]	Amperometric sensing	$1X10^{-4}$ M to 0.26 M
Present Method	Colorimetric sensing	1 mM

It is true that comparing to earlier reports, the detection limit in the present work is high (1 mM). Glucose concentration even in health state is high (80 mg/dL, 4.44 mM). Our objective

in this report is to design a simple approach based on already available chemicals in the market without any tedious synthetic protocols. Such an approach can easily be carried out particularly in a rural set up of a third world country. Another advantage of the method is that the concentration dependant color change can be visualized by naked eye and it is enough to get a qualitative understanding on the level of glucose in the sample. In that sense, we feel that detection limit is not that much important. That is clinically relevant blood glucose level can be detected using this method.

3-aminophneyl boronic acid used as probe in reference 1 (table shown above) is less selective to glucose. The strategy used in the second reference need tedious chemical reactions including the use of organic solvents. All other methods used amperometric or electrochemical sensing mechanism for glucose detections which demand training to analyze the results. We have developed a completely green approach without employing any organic solvents for the development of glucose sensing probe using commercially available reagents. Also the visibly color change upon addition of glucose makes this method applicable to remote areas where sophisticated instruments are not available.

Study of interference effect from metal ions, amino acids and ascorbic acid

Based on an earlier reported paper seven different metal ions taken in the concentration of 1 mM and its absorbance measured in the same way as that of glucose solution[8]. The interference of randomly selected six amino acids and ascorbic acid were also studied. The relative absorbance of interfering agents along with glucose is shown as Fig S 1. It is evident that the developed probe is free from any notable interference by non-glucose constituents of blood.

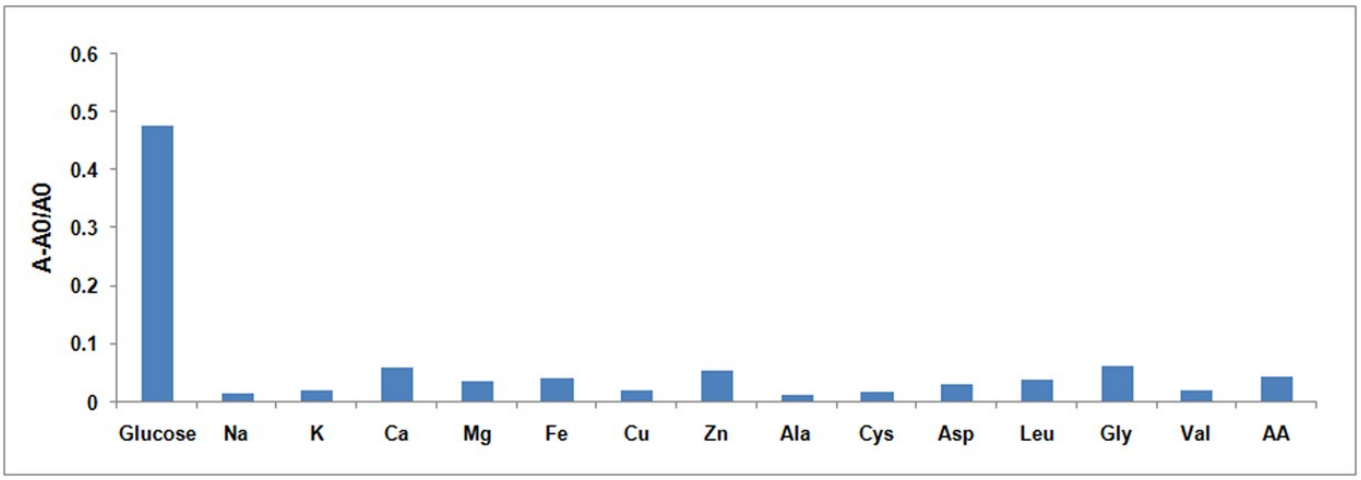

Figure S1: Relative absorbance of interfering agents Ala (d-Alanine), Cys (L-cysteine), Asp (L-Asparagine), Leu (L-leucine), Gly (Glycine), Val (L-Valine), AA (Ascorbic acid) and metal ions.

Determination of stoichiometry of inclusion complex CPBA-CD

We prepared the inclusion complex of CPBA and CD as per guidelines given in the literature (reference 21 in the revised manuscript). Briefly excess amounts of CD and CPBA were taken and grinded thoroughly in a mortar for 30 min with the addition of excess ethanol. The precipitate formed was collected, dried and kept in desiccators.

It is known that CPBA has absorption in the UV region while CD is free from any absorption in the same region. We assumed that the absorption of the complex also is from CPBA. We prepared standard solutions of CPBA for quantitative estimation CPBA in the complex. The absorption spectra of CPBA and the inclusion complex are shown in Figure S2. For the calculation we took the absorbance of peak at 278 nm. The stoichiometry of the inclusion complex is derived from the absorption spectra as detailed below. For the ease of calculation we used the concentration of CPBA and complex in mg/mL

The concentration of CPBA = 0.2 mg/mL

Absorption intensity of 278 nm peak for CPBA = 0.992

The optical density of 278 nm peak for the complex = 0.374

The concentration of CPBA in the complex = (0.2X0.374)/0.992 = 0.0754

Concentration of the complex = 0.3667 mg/mL

The concentration of CD in the complex = 0.3667-0.0754 = 0.2913 mg/mL

From these values, it is clear that 0.2913 mg of CD binds 0.0754 mg of CPBA. In that sense 1M of CD (Mole.wt 1134) binds 293.52 mg of CPBA (0.0754X1134/0.2913). Mole weight of CPBA is 146. 2 M is 146X2 = 292. The theoretical value (292) and experimental value (293.52) is closely agrees to indicate that the complex formed is 1:2. That is 1 M of CD binds 2M of CPBA.

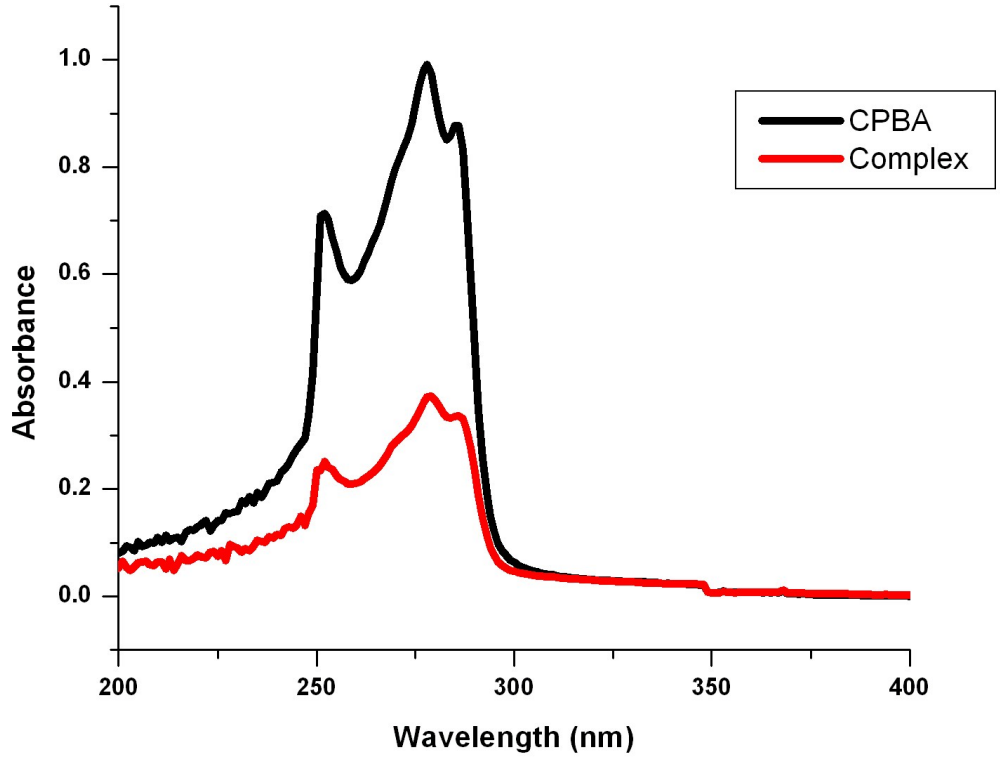

Figure S2: Absorption spectra of CPBA and CD-CPBA inclusion complex

Effect of pH on the stability of CPBA-CDGNP

The stability of the probe solution at different pH was assessed. We observed that the probe is stable in the pH range of 7 to 10 at pH 10.5 the solution got aggregated. Below pH 7 also the solution showed aggregation behavior. The absorbance spectra of CPBA-CDGNP at different pH conditions are shown as Figure S3. The glucose estimation was carried out at pH 8 and at this pH the solution is stable.

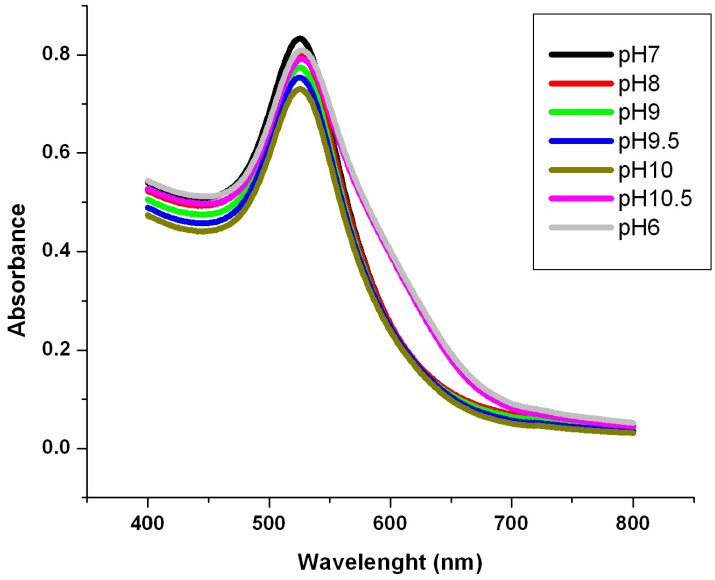

Figure S3: Absorption spectra of CPBA-CDGNP at different pH conditions

References

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